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Large

CANADIAN GEOGRAPHICAL JOURNAL

Boat brigade sets out from Fort Edmonton down the Saskatchewan River to York Factory, about 1825.

CONTENTS:

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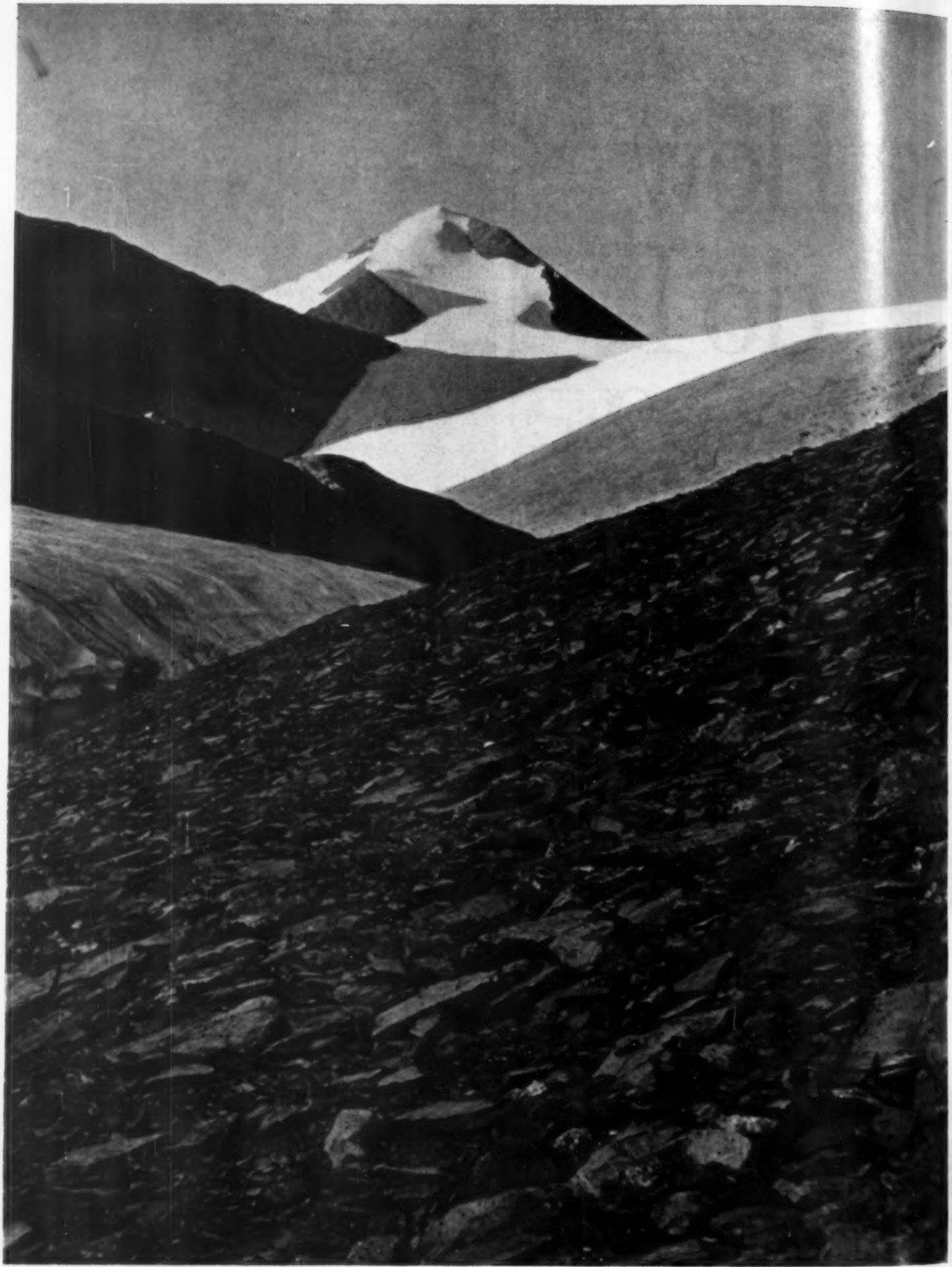

This is not what it might first appear to be, a mound of stones in front of a painted abstract backdrop. The peak in the distance is Mount Nukap, a nunatak east of Gilman Glacier in northern Ellesmere Island.
J. R. Lots.

✦

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CANADIAN GEOGRAPHICAL JOURNAL

Editor - WILLIAM J. MEGILL

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AUGUST 1961 ✦ VOLUME LXIII ✦ NUMBER 2

COVER SUBJECT:—By author of Confederation Life Collection.

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The articles in this Journal are indexed in the *International Index to Periodicals* and in the *Canadian Index*.

The British standard of spelling is adopted substantially as used by the Government of Canada and taught in most Canadian schools, the precise authority being the Concise Oxford Dictionary, fourth edition, 1951.

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Mechanized transport for ice and snow; a motor toboggan and sledge on Gilman Glacier.

The older but still effective means of transport over ice and snow; a sledge party of the first expedition to explore the interior of Ellesmere Island at the snout of Gilman Glacier in 1935.

(Opposite) One of the first photographs ever to be taken in the interior of Ellesmere Island by A. W. Moore in 1935.

Operation Hazen

The First Summer, and The Winter Party*

by J. R. LOTZ

In late April, 1957, six scientists assembled at the R.C.A.F. station at Uplands near Ottawa. Our orders stated that we were "to proceed to the Lake Hazen area in northern Ellesmere Island to carry out Operation Hazen". Several years of serious thinking, and much detailed planning had preceded the departure of the advance party of the large airborne expedition that was to be one of Canada's contributions to the International Geophysical Year. Most of the burden of the planning had fallen on the shoulders of two members of the Geophysics Section of Canada's Defence Research Board, Trevor Harwood, and Dr. Geoffrey Hattersley-Smith. Rather than attempt to put in a purely government expedition, it had been decided to ask universities to participate in the scientific study of a remote part of the Arctic; in this way it was possible to draw on a larger group of experienced specialists. The outstanding success of "Operation Hazen" can be attributed to the way in which the universities and government departments co-operated with the Defence Research Board, which, in turn, was able to call on the Canadian services for logistics support, equipment, personnel and supplies.

The principle adhered to throughout the sixteen months that the expedition was in the field was that only scientists would be involved, supported for short periods by Army specialists, and R.C.A.F. aircrews. The result of this was that little time was wasted on "housekeeping" in the field, and support facilities were kept to an absolute minimum.

"Operation Hazen" was planned as a three phase operation. In the summer of 1957, eight scientists were to carry out reconnaissance studies. During the winter a party of four men would man a station at the Lake Hazen base camp, and keep a continuous weather record. During the following summer, a larger party was to continue and extend the work of the first season, and other specialists were to initiate studies in zoology, botany, geomorphology, and archaeology.

The choice of the Lake Hazen area as a site for a large scientific expedition was governed by several considerations. Located in the furthest north of Canada's Arctic islands, the region lay beyond the 81st parallel, and yet was relatively accessible by sea; planes could land on the frozen lake in spring. Although visited in 1882, 1914, and 1935, the interior of northern Ellesmere Island was almost unknown. From the accounts of Greely, the only person ever to visit the area in summer, it appeared that the Lake Hazen region was an Arctic paradise. Beyond the lake was a vast area permanently covered with ice. What was the regime of the glaciers in this unknown region ? Did Lake Hazen become ice free in the summer ? What Eskimo peoples had lived in the area, and when ? All these and many other fascinating

*Published by permission of the Chairman, Defence Research Board

Photographs used in this article are by the author for the Dept. of National Defence, Dr. R. L. Christie for the Geological Survey of Canada, Lord Shackleton, John Powell, and R.C.A.F.

questions of geology, meteorology, glaciology, botany, zoology, archaeology, biology, geomorphology, and limnology awaited an answer.

From considerations of strategy, scientific possibilities, and logistics, Lake Hazen was an ideal place for a full scale expedition. The distances involved in actually reaching the region were great. Lake Hazen is some 2500 miles due north of Ottawa, and so is actually nearer to London, England, than to Canada's capital. The operation, therefore, was staged through Fort Churchill, Manitoba, and Thule Air Base, Greenland. Hundreds of different items, scientific equipment, tons of dog food, and rations were ready for the expedition when the advance party arrived in Fort Churchill on April 27th.

Led by Dr. Hattersley-Smith, it was the task of this party to establish a base camp on Lake Hazen, and an advance camp on the Gilman Glacier. In addition to Dr. Hattersley-Smith, who served as leader of the expedition and glaciologist, the first party consisted of K. C. Arnold, surveyor, University of Toronto, Dr. R. L. Christie, geologist, Geological Survey of Canada, Dr. Fraser Grant, geophysicist, University of Toronto, Professor Roger Deane, Pleistocene geologist, University of Toronto, and myself, as micrometeorologist, from McGill University. At Fort Churchill, we were joined by Sergeant David Engel, Royal Canadian Engineers, who was to serve as vehicle driver and mechanic.

In the initial establishment of the base camp, two C-119 "Flying Boxcars" of R.C.A.F. Air Transport Command were used, and these were loaded at Fort Churchill. The flight to Thule was uneventful, and after a hasty meal there, Sergeant Engel and I climbed aboard the plane carrying a bulldozer, and strapped ourselves in.

The flight to Lake Hazen took a little over two hours. We flew swiftly over frozen seas, crossed the coast of Ellesmere Island, and roared over the snow covered land. And then, in the distance, the mountains north of Lake Hazen appeared. White ranges stood out in sharp relief against the blue evening sky, and at their foot lay the great flat expanse of Lake Hazen. It looked exactly like what it was—a huge natural airfield in the interior of Ellesmere Island.

The plane circled, then came in to land. On the north shore of the lake a small gravel flat jutted out opposite Johns Island. It was on the lake ice between this flat and the island that a landing place had been selected from the air. Here the first camp was to be established, and the snow cleared to make an airstrip.

A landing on the lake ice, and on the Gilman Glacier, had been made in late March by ski-wheel DC3 to test the snow conditions. They were perfect for plane landings, even on wheels. Our C-119 touched down gracefully and gently, ran in towards the west end of Johns Island, and stopped. I opened the rear door, and dropped out.

In a silence I could almost feel, an incredibly beautiful sight greeted me. I had jumped into about six inches of soft, uncrusted snow, and from the surface of this snow the sun's rays were reflected like a million diamond points. The snow stirred up by the C-119's engines put a rainbow halo around the midnight sun. Beyond the shores of the lake rose the ranges that stood sentinel on the outskirts of the interior icecap. But there was too much work to be done to stay lost in reverie in this Arctic solitude. The rear "clam shells" of the C-119 swung open, the ramps were dropped, and the yellow tractor, driven by Sergeant Engel, emerged from the hold of the plane. Then the C-119 took off.

Almost as soon as the noise of its engines faded, a silver speck appeared to the south. The second C-119, carrying the other members of the expedition, landed as perfectly as the first on the unprepared surface of the lake.

The next few days were hectic. Bundled in Arctic clothing, under a sun that resolutely stayed in the sky for twenty-four hours out of twenty-four, we manhandled, hauled, lifted, pushed, pulled, and tugged at every size of box, barrel, crate, and drum.

Out of one plane spilled the two teams of husky dogs that were to provide most of the transport for the expedition. The dogs were fine looking animals, well fed, and in excellent condition. Secured for us through the courtesy of the Danish authorities in Greenland, they came from the village of Kanak (New Thule). With them came two heavy Greenland *komatiks;* lighter Nansen sledges were brought in in sections and assembled at the camp.

At first, the sledge dogs appeared as a

An aerial photograph of the Lake Hazen area during August.

homogeneous group, with wagging tails, lolling tongues, and insatiable appetites. Only gradually did their distinctive characteristics appear. One-and-a-half teams were used on the glacier and six dogs were kept at base camp. Those at base camp were little used after the lake broke up. Sometimes the dogs irritated us, breaking loose and fighting even when they were pulling the sledge, but usually they provided a ready source of amusement. To see the young dogs frolicking on fresh snow, playing with each other, while others lay stretched out in the sun, made us wonder exactly what constituted a dog's life.

There seems to be some belief that the employment of dog sledges as a means of transport is more suited to the era of exploration in the Arctic than to that of its scientific study. The advantages that the use of dogs have over motor vehicles in an area such as the interior of northern Ellesmere Island are very great. Dogs can pick their way easily over a melting glacier surface, and can be used to pack supplies over land. They require no huge caches of fuel to be laid down for them. One case of food, weighing sixty pounds, will sustain a team for six days. Neither weather, snow, nor ice conditions stopped the dogs, and where mechanical transport could be used the dogs were towed

Unloading on lake ice in April 1957.

on the sledges. No time was lost because of mechanical breakdowns. When a sledge runner was smashed it was easily and quickly mended, without the need for elaborate workshop facilities.

By May 3rd, all supplies had been flown in to the lake, and it was decided to establish the Gilman Glacier Camp. Deane and Christie were left to transfer all the stores and supplies to the side of the lake while the other expedition members flew by DC3 to the glacier. Here a landing was made at 3300 feet, and tents hastily pitched. The dogs came in on the second flight, and a final flight brought in all the food, supplies and equipment that would be needed for our three months' stay. Meanwhile a "Flying Boxcar" carried out a successful "paradrop" of dog food and other bulky items. In a few hours a small tent camp arose, with the supplies stacked all around.

The weather conditions at Lake Hazen had been ideal, and the initial airlift had proceeded under clear skies and calm conditions. We hastened the unloading of planes in the belief that the weather was too good to last. Just after the tent camp on the glacier had been established, a wind began to rise. Gradually it became a blizzard, and drifting, blowing snow enveloped the tents. After a continuous blow of two days, the wind slowly slackened, and we were left to dig out our supplies and stores from beneath huge drifts.

The blizzard was the only one experienced on the glacier during the summer of 1957. One of the most important results of "Operation Hazen" was the confirmation that this area is one with the best weather in the Arctic, marked by light snowfall, an absence of strong winds, and relatively little cloud.

As soon as the stores and equipment were dug out, the scientific work started. Synoptic weather observations began on May 18th. By early June, a thirty-foot mast had been erected, and anemometers and thermistors installed on it for wind and temperature measurements at four levels above the glacier surface. A deep hole was cored into the glacier by hand. From the fifty foot core recovered, it was possible to determine the regime of the

glacier during the previous years. At fifty feet below the ice surface, the temperature was —18°C (0°F), which indicated that this was about the mean annual temperature for the area. Rows of stakes were set up. These were to serve a dual purpose—as permanent stations for ablation and accumulation studies through the following years, and as markers for movement studies of the glacier. From survey stations set up on the shoulders of the mountains that bordered the Gilman Glacier, the stakes were shot in, and their positions fixed. Geological studies were begun, with visits to surrounding nunataks*. The seismic equipment was assembled and tested. On May 19th, Hattersley-Smith, Grant and Arnold left the Gilman Glacier camp, and sledged to base camp. I remained to continue the weather observations, and to put in more ablation stakes.

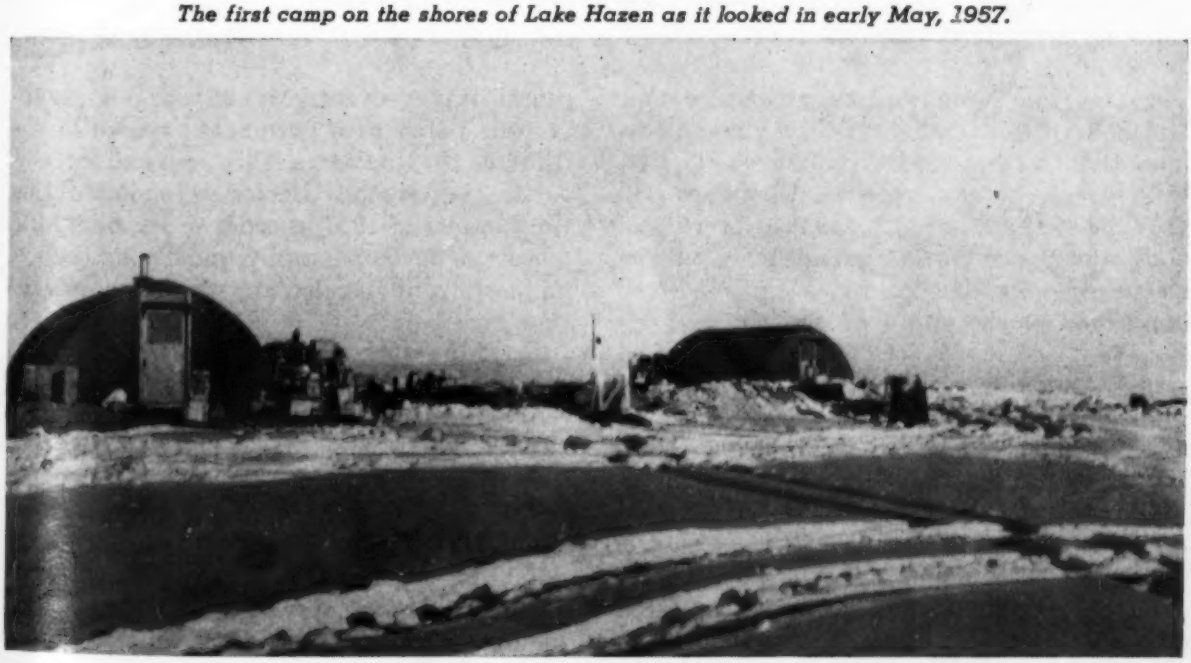
The journey by the three men was in the tradition of the early exploration of northern Ellesmere Island, and made everyone grateful for the ease and facility with which the R.C.A.F. had delivered us and our equipment to that inaccessible place. One-and-a-half hours sledging brought the party to the snout of the glacier. Unloading the sledge, everything was lowered down the snout of the glacier by rope. From the glacier snout, there was hard travelling over boulders, gravel and blocks of ice, and then another unloading when the sledge was let down into the Gilman River valley. From here the travelling was better, although deep snow slowed the sledge at times. At the mouth of the Gilman River, the trail left by the oversnow vehicle led the party to within ten miles of the camp. Here the oversnow vehicle awaited them. This route to base camp became a well travelled one during the summers of 1957 and 1958.

At the base camp, the Attwell shelters were up, and everything neatly stored. On May 28th, Hattersley-Smith, Arnold and Christie set out to return to the glacier camp. Towing the sledge with the dogs sprawled on it in easy comfort, the oversnow tractor reached the Gilman River mouth, and then returned to base camp. From the river mouth, the three men sledged up the Gilman valley, and reached the snout.

During the next few days, the scientific work continued. Like most scientific work, it was routine, and sometimes monotonous. The weather stayed beautiful and sunny; it was possible to strip to the waist despite temperatures in the 20's. On June 2nd, a "Flying Boxcar" roared over the camp. This plane had brought in Hal Sandstrom and John Filo, both from the University of

*Nunatak—an ice-free mountain or mountain peak situated in an area of ice, such as a glacier or an ice-cap.

The first camp on the shores of Lake Hazen as it looked in early May, 1957.



Gilman Glacier from the air.

Toronto, who were waiting at base camp. Hattersley-Smith and Christie sledged off to meet them on June 3rd; Arnold walked down to the glacier snout on the following day.

While at the snout, some survey work was done, and the level survey was carried up the glacier. Snouts of glaciers are particularly important in the study of glaciology. It is here that the most obvious indications of a glacier's advance or retreat are to be found.

In mid-June, the seismic work began. To discover the depth of ice, an explosive charge is set off at the surface of the glacier. The sound waves from the explosion travel down through the ice, and are reflected from the top of the rock lying under the glacier. At the surface, geophones pick up the reflected sound, and pass it along to amplifiers. The sound waves eventually appear on photographic paper as a permanent record of the distance they have travelled. Several sections across the Gilman Glacier were shot during the summer of 1957 in order to get data for a picture of the topography underlying the ice, and to be able to calculate the actual mass of the glacier.

On June 20th, the expedition leader and Arnold left on a historic trip. The sledge party that left the Gilman Glacier camp was only the second to penetrate into the interior of this unknown land. Two days sledging brought the two men to Mount Oxford, which they then climbed. From this vantage point they saw the interior of northern Ellesmere Island spread before them, with mountain chains and peaks rising above the

eternal ice. The whole day, a calm, clear one, was spent in taking photographs, and making theodolite observations. Two prominent peaks stood out strikingly in the white landscape, and were noted again during flights over the area in 1958. Near the head of the Henrietta Nesmith Glacier, in latitude 82°01′, a mountain rises to about 8,250 feet. This is probably the highest mountain on Ellesmere Island, and therefore the greatest elevation in Canada east of the Rockies. In an area of spectacular, unclimbed, unnamed peaks, one, Commonwealth Mountain, stands out strikingly. It lies at 82°24′, and soars up almost 7,500 feet sheer from the head of M'Clintock Fiord.

The Mount Oxford region lies above the firn line, whereas the Gilman Glacier camp was located about 500 feet below this demarcation line between the ablation and accumulation zone of the glacier. By digging a deep pit near Mount Oxford, it was possible to study the annual accumulation of firn (melted and refrozen snow) over the past twenty years. This was a valuable aid in determining the past climate of this area.

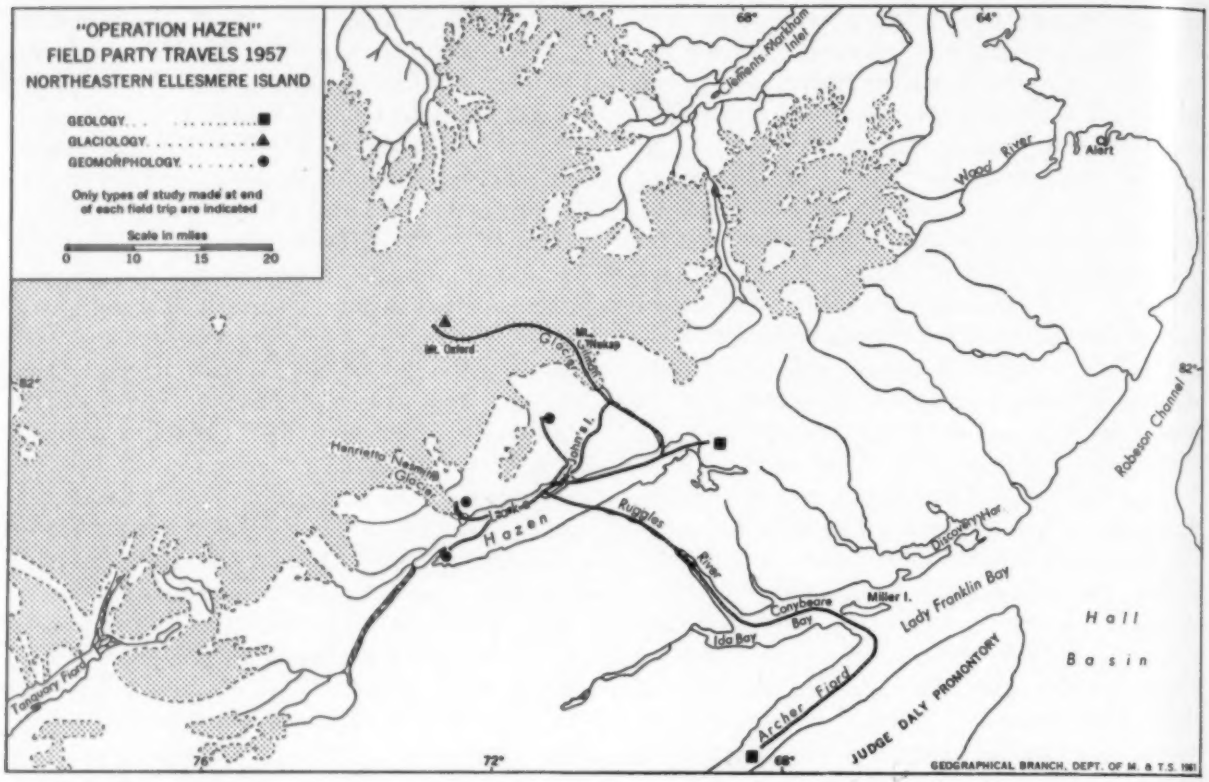
At the base camp too, much travelling had been done. While the ice on the bays still held, Deane and Christie sledged across the lake and down the Ruggles River, to Chandler Fiord, Conybeare Bay, Ida Bay and Archer Fiord. In early June, the sun's warmth was already stripping the snow from the hills around Lake Hazen. The melt season on the glacier began in the last week of June. On June 25th, Deane arrived at the Gilman Glacier camp after a difficult walk up from the lake in the height of the thaw. In the melt season, three feet of snow and ice disappeared from the surface of the glacier in the camp area. Tents therefore became raised above the surface of the ice and had to be shifted.

On June 27th, Hattersley-Smith, Arnold and Deane set off for the snout of the glacier. After accompanying Deane a few miles to speed up the trip, the other two investigated the upper valley of the Gilman River to the west of the glacier terminus. Here thirty musk-oxen were seen and photographed at close range, and what appeared to be an ancient tent ring was discovered. It measured six feet by four feet, and represents the furthest north that any trace of Eskimo settlement has ever been discovered in Canada.

During July, scientific studies proceeded at both the base camp and on the glacier. The seismic crew, constantly on the move, extended their studies up into the icefield southeast of Mount Oxford. The sides of the glacier and the tributary glaciers flowing into the Gilman were visited. Micrometeorological observations were made at two-hourly intervals from eight in the morning until ten in the evening. Glaciological studies involved the digging and boring of holes above the firn line.

At the base camp during July, geological studies were made at both ends of, and along the shores of Lake Hazen. The hills and ranges fronting the lake were examined, and the

The tent camp on Gilman Glacier. Mount Nukap is in the background.



lake itself and the rivers draining into it were studied by Deane. The lake yielded an abundance of fresh, delicate-tasting Arctic char.

By the end of July, the scientific studies on the Gilman Glacier were nearly completed. From our records we would be able to tell how much ice the glacier lost during the summer, and how much it gained during the winter, how many tons of ice were locked up in the glacier, and how deep it was. These records would provide a useful starting point for the study of this unknown area. The main aim of the expedition had been successfully accomplished.

On August 14th, Arnold, Sandstrom and Filo left the glacier camp to survey their way down to the base camp. On August 9th and 10th, the three remaining members of the party travelled down glacier and shot the last seismic profile. On August 12th, with the Greenland *komatik* loaded up, we made a final check of the camp, and then began the long journey home.

We reached the edge of the glacier without mishap. The sledge was cached, and its cargo transferred to dog packs, each dog carrying about fifteen pounds; we each shouldered fifty pound packs. A convenient snow ramp led us off the glacier on to a scree slope, and from here we followed the side of the glacier until we reached the upper Gilman River. Near the snout of the glacier we pitched camp.

On the next day, we set out to keep our rendezvous at the mouth of the Gilman River. Christie had visited the camp in July, and we had arranged to meet him at the mouth of the Gilman River—if the lake was open. Otherwise we were to walk along the lake shore to the base camp.

It was late evening by the time we began to drop down towards the lake. At the crest of each successive ridge, we scanned the horizon for any sign of open water. Finally, within a few miles of the lake, we topped the last ridge, and there before us lay the lake—completely free of ice. By the time we reached the tent, our dogs were worn out. This was the last work that the dogs had to do. Until they returned to Kanak, they could get a well earned rest.

On the next day, Hattersley-Smith and I returned by boat to the base camp; this was on August 14th.

At the base camp, everything was ready for departure. The survey had been carried over to Johns Island, and tied into the Shoran station there. After a busy summer, we finally had time to relax at base camp. We knew that the United States coastguard cutter *Eastwind* was on the way to evacuate us, and to bring in the winter party, but the ice conditions in the channels between northern Ellesmere Island and Greenland could delay the ship for days. The *Eastwind*, however, made the passage from Thule in forty-one hours, and anchored in Chandler Fiord, less than twenty-miles in a direct line from the base camp.

On August 15th a big helicopter settled down less than a hundred yards away from the Attwell shelters, and out dropped the "Operation Hazen" liaison officer, Lieutenant-Commander Jim Croal, R.C.N., and the leader of the winter party, Dick Harington. With three others from McGill University, he was to winter over at the base camp. For the next three days, the shuttle between the base camp and the coastguard cutter went on. The contrast between the coastal and interior weather in northern Ellesmere Island was demonstrated by the number of times that the ship lay under low stratus in the fiord, while the base camp enjoyed clear skies. The helicopter flew up the Ruggles River, and then across the lake. While the flights were going on, *Eastwind's* launch sounded the fiord, and the ice dam where the Ruggles River joins Chandler Fiord was examined.

Dr. Fraser Grant weighs one of the puppies born on the glacier in the summer of 1957.

Finally, all eight members of the summer party were flown out together with dogs, puppies, equipment, specimens, and records. At the base camp, the four men began to

Two of the pack dogs, Engelbrecht and Rex, try to get some relief from the mosquitos by lying down in the mud of a small stream.

The four men who wintered over at Lake Hazen—left to right: Ian Jackson, David Smith, Dick Harington, John Powell. The sheet of paper bears the inscription "September 1957".

John Powell carries a piece of local coal over the threshold on January 1, 1958.

prepare for winter. In addition to Harington, who was to carry out wild life studies as well as acting as leader, the party comprised John Powell, a plant geographer, David Smith, a geomorphologist, and Ian Jackson, meteorologist.

On August 18th, the *Eastwind* weighed anchor, and sailed out of Chandler Fiord. Stopping only at Alexandra Fiord, and Kanak in Greenland, the ship docked at Thule on August 23rd.

While the summer party were enjoying showers, shaves and the luxury of clean clothing on the icebreaker moving towards Thule, the four men of the party left at base camp were preparing for the long winter.

Regular weather observations began at midnight, Greenwich time, on August 20th,

1957, and continued at three-hourly intervals right through until the following August. Thermistors, for measuring the temperature one, two and three feet below the surface, were located near the hut, and read regularly. Records were kept of aurora displays during the winter darkness, and each man was a member of the Canadian Ground Observer Corps.

On January 14th, the minimum temperature fell to −68.5°F, the lowest temperature recorded during the winter. From the meteorological record it became apparent that the Lake Hazen area is the site of a huge temperature inversion. Here cold air collects, resulting in low temperatures and a prevalance of light winds and calms.

By the end of January, there was light on the southern horizon, as the sun slowly returned. On March 1st, the sun was above the horizon, although obscured by cloud, and on the 12th, the stars began to disappear. The ice prisms in the atmosphere gave rise to many optical illusions.

On March 30th, a United States Air Force "Hercules" plane landed on the prepared runway on the lake.

With the end of winter, life began to return to the Lake Hazen basin. Foxes and musk-oxen were sighted, and the first snowy owl appeared on April 4th. Harington made a trip to Chandler Fiord, finding the outlet of Lake Hazen at the Ruggles River still unfrozen.

Now the sun was climbing high in the sky, and by the time the summer party arrived on April 29th, there was continuous daylight. It was extremely heartening for the members of the third phase of "Operation Hazen" to find the winter party fit, well, and in good spirits. All except Harington sported large and rather fearsome beards. The leader of the winter party summed up the reasons for the success of the second phase of "Operation Hazen" when he stated that, "The high morale of the party during the winter phase was due largely to mutual consideration, a desire to keep active mentally and physically, good food and living conditions, plus the real essence — a sense of humour".

The base camp hut in April.

A fly-fisherman's ideal — firm footing, no crowded brush, fast water and lively trout — situated a mile inland on the Labrador coast and a world away.

Sport Fishing Near The Arctic Circle

by JOHN P. OUGH

WHATEVER else is said about the Canadian northland — it has wonderful fishing. From the coast of Labrador, through the regions of Hudson Strait and Bay, across the barrens to the Yukon in the west, four members of the *Salmonidae* family provide angling sport supreme. Not only are the fish themselves charged with energy by the cold waters in which they live but the terrain lends itself to the sport in many ways.

Pick up your fly or spinning rod and let's take a summertime trip east-west across the Canadian sub-arctic.

Of course, few people would ever get an opportunity for such a trip in real life. But, quite a few fishermen who are also surveyors, engineers, technicians or scientists manage to visit one or two good fishing areas each year. So, though this trip actually took place over a number of years, in imagination we can compress it into a few glorious weeks of angling unhampered by the usual daily tasks.

Our first stop is about halfway up the Labrador Coast, somewhere near that indefinite boundary, the tree line. Standing on a gravel beach we can see the Atlantic Ocean stretching to the eastern horizon. Just above high-water mark the brush grows densely but a few hundred feet up the hillsides the bushes rapidly lose their size and number and the bald rock starts, broken only by a stubborn stand here and there and a patch of white where a left-over snow drift hides from the sun. But down here at the water's edge myriads of insects are buzzing, and to avoid them by pushing through the brush, one collects a face-full of cobwebs.

A hundred yards along the shore and we come across a river. Not too wide, but there's quite a lot of water gurgling over the few feet of exposed gravel left by the falling tide. Upstream, the water comes tumbling down between great time-smoothed boulders, with here and there deep runs, but always on one side or the other are shallow stretches through which we can wade. Torn between our keenness to fish and the desire to see what's around the next bend we leave the water and

strike inland, parallel with the stream, along a sparsely covered ridge which allows periodic glimpses of the water. Half a mile further the sound of rushing water drowns out the hum of insects. An opening in the brush suddenly shows a wonderful cascade over a ledge of rock eighty feet high. It's like a colour slide suddenly projected onto a screen. We hasten forward, climb to the top, look down at the turbulence, deep blue, white and green, and then, looking west we see the first of the chain of lakes which act as a reservoir for these lovely falls.

Enough exploring. Let's get to fishing. Where the lake waters gather themselves for action and swirl with growing speed into the vortex at the head of the run-off, chance has conveniently placed several smooth, flat boulders. Standing upon them we cast small spinning lures into the deeps. Fly fishing will come later in the broken water of the stream below the falls. At once a fish. This calls for careful playing to prevent it being swept over the waterfall. We watch the hooked fish as it comes to shore. A fifteen-inch speckled trout, similar to those of Nova Scotia, Quebec and Ontario, with maybe a deeper tinge of olive-green to its back and sides. A good, solid fish, though, evidently no food shortage for him. With half-a-dozen more of a kind we can resist the rushing stream below no longer. Climb down the broken cliff edge and our flies are soon dancing in the rushing stream. The smaller speckled brook trout, twelve inches long, snatch the flies. Sometimes, on and off in a flash, the swirling current playing its part in the sport, the fly is at once grabbed again — by the same or another fish, who is to know ?

In quiet backwater pools a dangled fly in the inch-thick cover of froth invites a flurry of foam from the younger and smaller speckleds. A few hours lost in this sport and we find ourselves back where the salt water meets fresh. Now the tide is on the make and so into the flood water we cast our flies. Here are speckled trout with a difference. Up to eighteen inches in length they are silver all over from their trip to sea. Others, not so large, are alike in appearance to those in the stream. Evidently they have only taken a day excursion into the salt water, or perhaps, while dallying after some morsel in the brackish salt-water-mixed-with-fresh at high tide, missed the start of the ebb and, rather than splash up the exposed gravel beach to fall a victim of the gulls, waited out the dozen hours to the next high water.

Next day we go a dozen miles along the coast, then turn in at a large river in a quest for salmon. We start fishing at the river's mouth working our way gradually up-river. No salmon. Sea-run speckleds again, farther up a whitefish or two but no salmon. Three miles inland we find them. Past half a dozen raging falls a score of feet high we come to a deep silent canyon a hundred yards long. Looking down from the straight-up canyon walls we see hundreds of dark forms lying in the water, near the bottom, resting from their journey up river. A lure dangled down forty feet to the unbroken water of the silent run produces no effect upon the salmon. In fact they just swim casually out of its way. With a sense of intruding, we marvel for a while and then turn back for the coast. Tomorrow we start for more northern parts — Baffin Island.

Though on an ideal fishing trip we would like to bypass any habitation, we pay a visit to the base at Frobisher Bay, for, half a mile away is the mouth of the Sylvia Grinnell River famous for its run of Arctic char.

Even off the jetties, red and white spoons cast into the salt water are often taken by a fifteen pound Arctic char — a silver fish

with a beauty and fighting quality second to none, about on a par with its cousin the Atlantic salmon. For, though this beautiful fish possesses, in common with the other chars, minute scales and light spots on a darker body, it is so like the salmon that a few years ago quite a number reached the fish markets under the same name.

A mile up the Sylvia Grinnell River, beyond tidal reach, the fish, few less than ten pounds, can be seen in the deep water below the first shallow falls. For some reason when we visit them here they are not interested in our lures at all, just following but not taking. However, we have taken a few farther down river and must be satisfied with that.

If we were to take a helicopter and fly over to the mouths of other rivers a little to the west, we would be able to look down on other runs of char gathered below the first falls inland from the salt-water.

Passing through Hudson Strait we head straight across to the west coast of Hudson Bay. As we approach Rankin Inlet we see the eight-mile-long mass of quartzite known as Marble Island on the horizon. It shines brightly in the sunshine as if snow-covered, guarding the northern entrance to the inlet, and in the ground swell from the bare-rock shore a few white whales cruise back and forth. Throughout its thirty-mile length, the inlet is littered with shoals, rocks and islets. The last few years have seen the growth of a nickel mine at the northwest corner of Rankin Inlet and the close proximity of many fresh-water lakes must be a boon to the mine employees who are anglers.

A little way inland we reach strings of lakes lying amid low, rolling, and at this time of the year, almost prairie-like plains with here and there a gaunt outcrop of rock and hump-backed hill. Fishing in the first lake only a few hundred yards from the salt water, we catch lively lake trout up to twelve pounds in weight. Some of them that fight in a startling, vigorous manner seem to be a natural hybrid between lakers and Arctic char. Not surprising really, because down at the salt-water's edge we can see that the big char are there in large numbers and during the spring melt of May and June could easily enter the lake by the run off.

The lake trout here are vastly different fellows to the indolent 'greys' of the south. Most of them, even of large size, have long, streamlined bodies and often prowl along just below the surface and in the shallows with their large, orange dorsal fins protruding like a shark's. This provides a really keen thrill for the angler who sees a fin streaking for his spoon, reels in more swiftly, sees the curve of pursuit narrow down and then feels the hard tug of a strike.

The flat shorelines provide ideal walking and the absence of trees and brush makes for ideal fly fishing in the weedless streams and

A morning's catch of fighting lake trout on the west coast of Hudson Bay. In the afternoon, fishing continues with barbless lures, the fish being released unharmed.

High up in the Pelly Mountains, Yukon, small lakes like these are the home of vigorous fish often called "speckleds". Though biologists class them as young lake trout, their spirit, stocky build and colouring are far different from the lakers, young or old, from other nearby lakes.

lakes. Here, within sight of the waters of Hudson Bay and nearly 300 miles north of Churchill, we make our first acquaintance with the Arctic grayling. Seldom over fifteen inches, they avidly take a small dark fly and sometimes, when spinning for lakers, even an inch-long spoon. In this region, their large scales are as silvery as a whitefish along the sides, their sole body adornment being a few black spots. But in the water the greenish-blue spots on their flowing, sail-like dorsal fin glow with a strange luminosity.

In the barrens of the Northwest Territories thousands of lakes are the home of voracious trout who roam the shallow edges after the hordes of stickle-backs. Sharing the same waters are Arctic grayling which at times dimple the waters with a thousand rings.

Farther west into the barrens we find almost as much water as land. Pausing to fish a lake we are disappointed to see that lower temperatures have covered the lake with a thin sheet of ice, except for a small patch where an incoming stream a dozen feet wide gurgles into the lake. With spinning tackle we cast spoons across the 100-foot-wide open patch of water, to clang down on the ice on the other side. Reeling in, the spoon is dragged across the ice to fall with a 'plop' into the icy water. At once the lure is grabbed by a large fish which turns and bores back under the ice. With the fish making its runs under the ice the rod tip must be poked into the water to prevent the thin spinning line being cut by the ice edge. Fifteen minutes later, after a fight that would put his southern brothers to shame, the ten-pound lake trout is brought to net. Hours later similar size trout are still snatching at every other spoon dragged into the water in this manner. It seems as if they follow the spoon from under the thin, transparent ice sheet, boiling into fury at not being able to take, only to have it drop into their very mouths at the ice edge.

Travelling west again we finally leave the barrens and once more meet the tree line. Into Yukon Territory in the region of the Pelly River's headwaters, we are in mountain country with snow-covered peaks and tree-clad slopes, green valleys and blue lakes.

In this mountainous part of Yukon the large rivers that have contact with the remote sea contain numbers of the Pacific salmon. But at this time of the year the rivers are opaque with silt and we leave them in preference to the clear cold waters of the lakes and streams. The biggest lakes provide lake trout up to twenty pounds and large northern pike. Though the lakes are often miles long few are named and they remain in serene isolation.

The lake trout here are more inclined to fight deep down on the bottom of the lake, unlike their eastern cousins of the barrens who battle it out on the surface in fine style.

In the smaller lakes and fast-flowing streams we once more meet that gallant fish, the grayling. In this part of the Yukon the grayling are larger than those in the east, often attaining a length of eighteen inches. Though their colouring is much darker the bright spots on the dorsal fin are as pronounced as ever and their fighting spirit remains the same. The fish are so eager to take either fly or spoon, that a cast into the fast water of the river can hardly miss Though the grayling often come off the bait, it is seldom that another, or maybe the same one, does not at once snatch at the lure before it has gone more than a few feet. To land the fish unharmed, even with barbless lures, requires careful playing and gentle handling or their soft mouths are sure to tear.

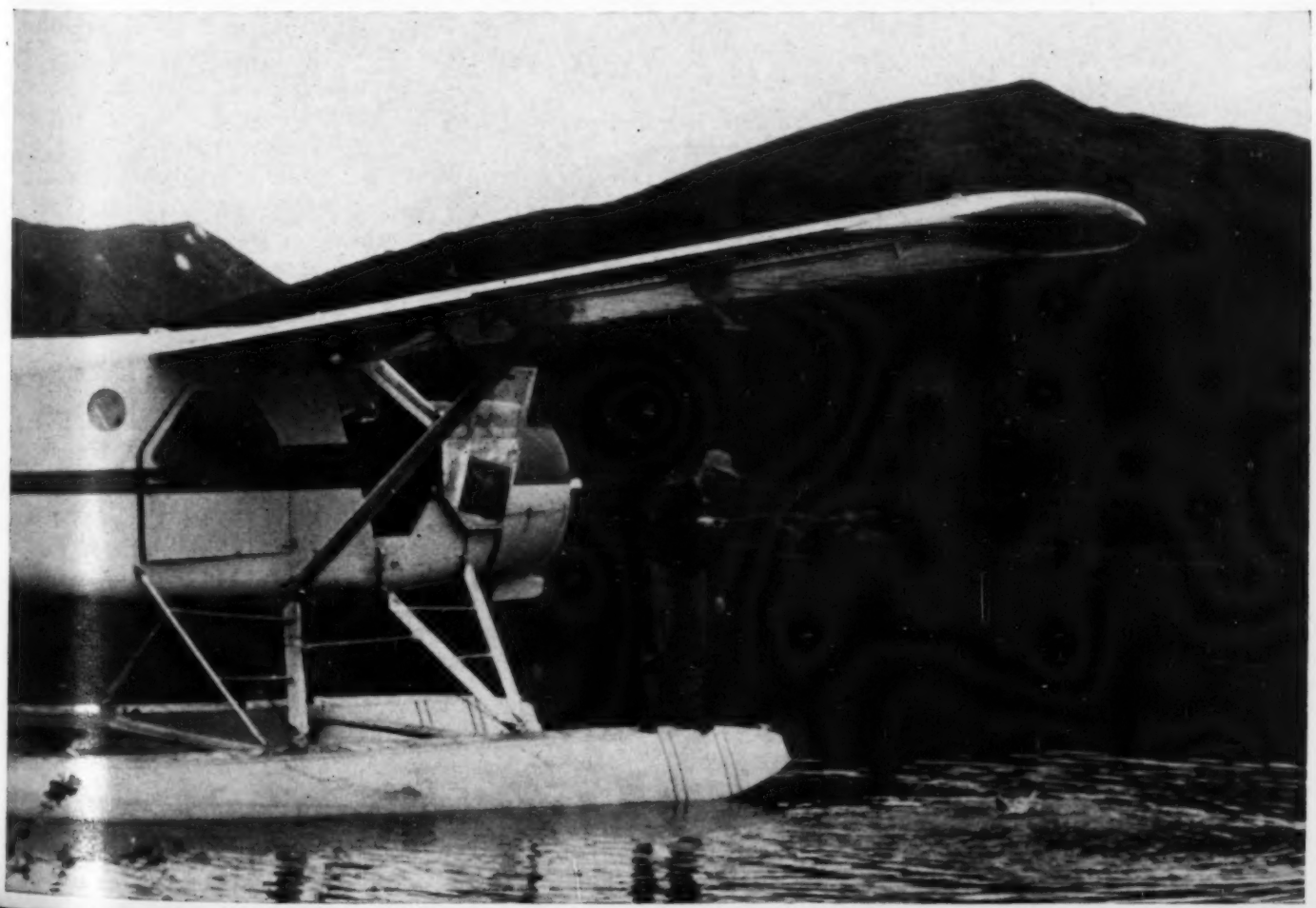
In one lake, small and high up the mountains, we catch, besides grayling, what at first sight are young lake trout. Yet their manner of fighting belies their size, and their clean shape and deep red meat makes us wonder if they are not a species of Arctic char that have somehow become landlocked far from the sea. So different are they from the usual lake trout that the people living in Yukon call them 'speckleds'.

So, after travelling across the continent we have had sport with three members of the char family: Arctic char, lake trout, speckled trout and that "dandy" of the northern waters, the Arctic grayling. We have sampled their game qualities in but a few of the myriads of virgin lakes and streams that stretch across from ocean to ocean. It is certainly enough to whet any fisherman's appetite and stir his imagination to consider what magnificent places must be waiting to hear the stroke of a fly line or the hiss of a reel.

This Yukon grayling shows off the bright, greenish-blue, luminous spots on his fins to full advantage. Take him from the water, however, and his spots will disappear.

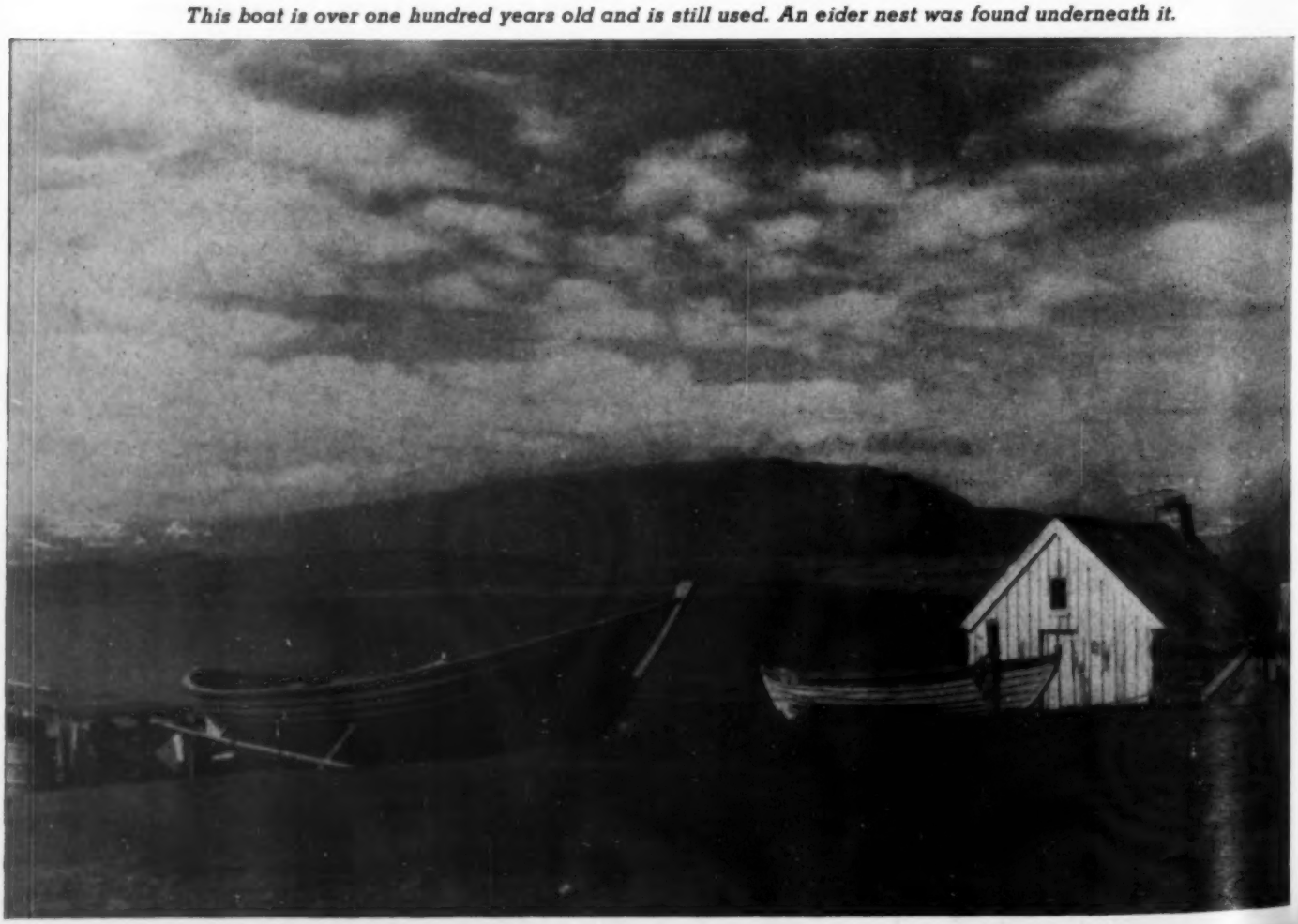
This large lake in the Yukon supports a thriving lake trout population and many grayling but the outflow river provides the best grayling sport. A cast into the fast waters a few yards from the lake itself just cannot miss.

The really complete angler! What would Izaac Walton think of this scene in the Yukon? Good as the float-plane is for wilderness travel, the best fishing is done on foot from shore or shallows.



An oystercatcher flies along the rocky shore of Vigur, an island in Isa Fjord in northwestern Iceland.

This boat is over one hundred years old and is still used. An eider nest was found underneath it.



The Eider Farms of Iceland

by DAVID A. MUNRO

Photographs by the author for the Canadian Wildlife Service

BALDUR Bjarnsson nudged the sleepy-looking duck with his boot, and slowly, with an appearance of only mild resentment at being thus disturbed, she took several waddling steps to the side of her nest, there to settle down peacefully on her breast again and await further developments.

"Bill", I said, "Those are *wild* ducks, but they're more tame than barnyard mallards!"

We watched in amazement but the female eider duck took barely any notice, as Baldur bent over, picked an egg from her clutch and set it carefully in his wicker collecting basket. Then he moved a few feet to the next nest for another egg and thus he and his family worked their way through the 200-acre colony.

We were on the Island of Vigur in northwestern Iceland, staying in the Bjarnsson's farm home, studying the Icelandic practice of eider husbandry.

Nowhere in the world is there a closer relationship between wild birds and man than that of the common eider duck, *Somateria mollisima* and some Icelandic farmers. Based on the demand for eiderdown, the most luxurious natural insulating material known to man, this *rapport* has been fostered by stringent protection and careful husbandry. An Icelandic eider farm provides one of the best examples in the world of careful harvesting of a natural resource.

The eiders are large ducks weighing as much as five and one-half pounds. From a distance the males show a conspicuous black and white pattern. The top of the head, flanks, lower abdomen, rump and tail are black; the cheeks, neck, breast and the forward part of the back appear white. At closer range, pale green patches on the cheeks and nape may be seen. The breast is tinged with a delicate pink. The female is brown, closely barred with blackish brown. The downy young are dark, dull brown above and dingy grey below. When fully grown the young of both sexes resemble the mature female. Males do not attain their adult plumage until they are three years old, but as yearlings and two-year-olds they show whitish patches which foreshadow the splendid attire they will assume when mature.

The tiny, fluffy feathers which grow beneath the outer breast feathers of the female eider are known as eiderdown. An individual down feather is fan-shaped. It has a light, flexible central vane, from one end of which radiate numerous fluffy branches. A single feather, spread out, would scarcely cover a five-cent piece. It is whitish at the root and brownish-grey around the edges. A mass of eiderdown appears brownish-grey, flecked with white. It is marvelously light and soft, and is so compressible that the amount which can be wadded up in a man's fist will, when released, expand to the size of a canteloup.

Eider ducks inhabit the cold waters of the Northern Hemisphere. Their breeding places are on the shores of northern Canada, Greenland, Iceland, northern Europe and Asia, and the islands of the Greenland and Barents Seas. There are a few colonies as far south as the Bay of Fundy in North America and along the coasts of the North and Baltic Seas in Europe. In winter, some eiders may move a short distance southward to avoid the drifting pack ice, but may remain near their breeding grounds throughout the year.

It is not known when man first took the soft, grey down from the eider's nest and fashioned it into a warm garment or coverlet, but it must have been many centuries ago. Tales about St. Cuthbert, a prior of Lindisfarne of the seventh century who lived on the Farne Islands off the Northumbrian coast, credit him with having befriended the eiders and used their down and eggs. The famous English naturalist, John Ray, wrote about the eiders of the Farnes in 1786, "They build themselves Nests on the Rocks and lay good store of the very savoury and well-tasted Eggs; for the getting of which the neighbouring people let themselves down dangerously enough, and with the same labour gather the feathers (Eider dun our people call them) which are very soft and fit to stuff Beds and Quilts." Eiders still breed on the Farnes.

On Baffin Island, in the eastern Canadian

Eider nesting shelters of stone at Lon, on the north coast of Iceland.

Arctic, there are small stone structures like little "row houses", about one foot high and with open fronts. These are similar to those built as nesting places on Icelandic eider farms today. Some historians believe that that is evidence that the Vikings reached Baffin Island a thousand years ago and stayed long enough to develop an eiderdown harvest.

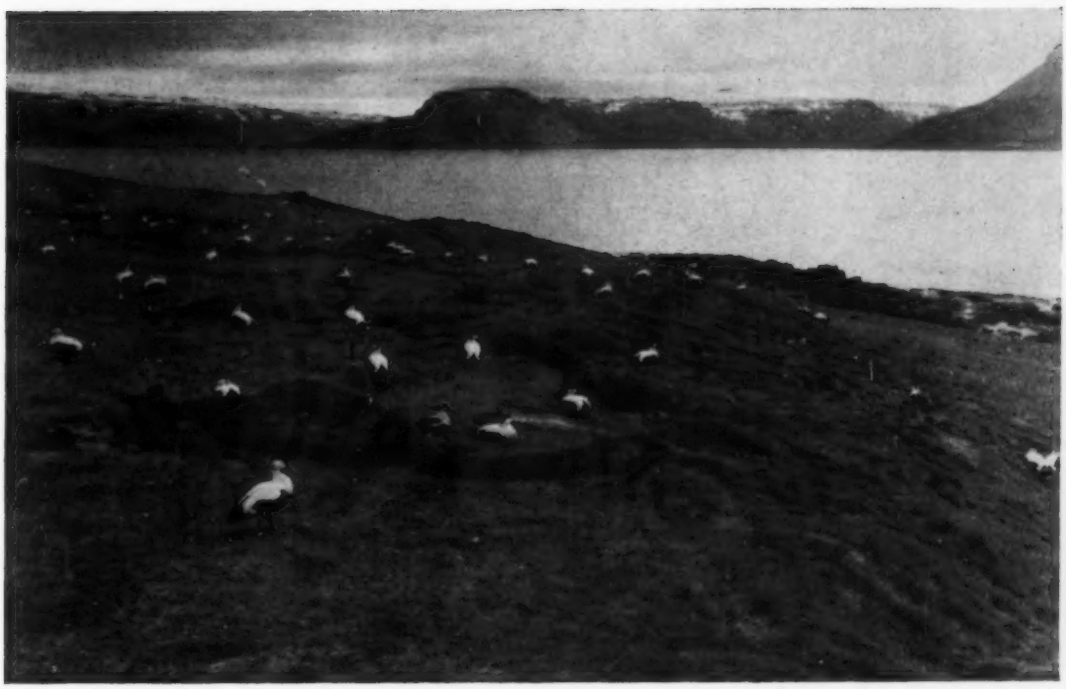
In Iceland itself, a land lacking such animals as reindeer, caribou or muskrat, the traditional sources of clothing material in Arctic countries, eiderdown was used at an early stage of settlement. Eiderdown was an article of trade between Iceland and Britain as early as the fourteenth century.

There are nesting colonies of the common eider in northern Britain, Scandinavia, and the Soviet Union. In all those countries, eiderdown has been used at one time or another.

Both Canadian Eskimos and Greenlanders once used eiders as a source of material for clothing, but instead of using the down from the nests and thus getting produce for a number of years from the same bird, they killed the birds and made parkas from the feathered skins. Those beautiful garments were so avidly sought by traders that eider populations were substantially reduced before their exploitation in that fashion was controlled. The Eskimos are now learning to take eiderdown as an annual crop.

Along the north shore of the Gulf of St. Lawrence, in the Province of Quebec, a true eiderdown industry started to develop in the years before the Second World War, but the changing economic conditions of the war and post-war periods practically eliminated it. Recently a Montreal firm has revived the local market for eiderdown and introduced from Iceland a rapid and effective method of cleaning it. Full development of the industry will take some years but the prospects are promising.

Icelandic eiderdown production is based on numerous managed colonies of eider ducks located on the west, north, and northwest coasts of the island. On Vigur, a narrow 200-acre island off the northwest coast, eider ducks were everywhere. We saw sitting females, each with their attendant male, in a kitchen garden beside the rhubarb, beside an outbuilding in a backyard, alongside the keel of a beached boat, in windrows of dried kelp at the head of the shingle beach, scattered on the hummocky green turf and on the soft, newly-turned soil of a plowed field.



Male and female eider ducks on Vigur. The females blend effectively into the surroundings.

Eider ducks may be found on the managed colonies only during the breeding season, which runs from May through July and is at its peak in June. During the remainder of the year they frequent coastal waters, sometimes remaining within a few miles of the breeding grounds, but generally being more dispersed in distribution. Winter distribution is greatly affected by polar ice. In years of excessive ice, many eiders may starve because the ice covers the shallow waters where they dive for blue mussels, the shellfish which are their staple food.

Mature eiders arrive on the farms in early May when the breeding season begins. Yearling eiders are not sexually mature and spend the summer in small flocks in the coastal waters near the colonies. During early May the breeding eiders perform elaborate rituals of courtship and form pairs. Then the females select the nest sites. An old female will often be seen year after year at the same nest site each spring.

During the early part of the nesting season at least, the sexual drive of male eiders is very pronounced. This is evidenced by frequent posturing and calling. Whenever a lone female turns up she is immediately sought after by a group of displaying males. In display the male stretches himself upward so that he seems almost to stand on his tail. First he points his bill downwards so that it is depressed on his breast. Then he flings his head and bill rigidly upward, uttering his mournful love call "yah-how-ooo", before resuming his normal posture.

In Iceland, some eiders start to lay eggs in mid-May. Most clutches are complete by the end of the month. The incubation period averages thirty days. The period during which young are hatched covers two months because of variation in times of commencement of incubation, and also because of renesting, which may occur if the first clutch is destroyed.

Females sit very closely during the incubation period, occasionally leaving the nest to drink and bathe. The Icelanders say that they do not feed during that time. Males attend the females at their nests for two weeks or more after incubation begins; then they leave and gather together in flocks away from the colonies. It is at that time that they undergo the annual moult.

Like all waterfowl, the young eiders are raised in the waters adjacent to the breeding grounds. After they are fully grown they may move away to their wintering locations.

A woman reconstructs a damp nest with a base of dry hay. Some down will be taken and the rest put back with the eggs.

In Iceland all colonies of the common eider are located at tidewater and most are on islands. The sites of the colonies are privately owned and, according to Icelandic law and tradition, so also are the ducks while they are on their breeding grounds. Stringent governmental regulations prohibit the shooting of eiders at any time and thus back up protective efforts made by the individual farmer.

If protection of the birds is the keystone of eiderdown production in Iceland, carefully planned utilization of their products, and improvement of their habitat are important supporting factors.

The eggs of eider ducks are taken by the eider farmers but they may be used only by the farmers themselves and must not be sold. The farmers take a moderate harvest, usually only one egg from each nest and that only if the nest has four or more eggs in it. Eggs are collected at the commencement of the nesting season and care is taken that only the freshest eggs are taken. When an egg is taken from a nest, the collector covers the remaining eggs with down so that they will not be so readily visible to great black-backed gulls or ravens.

Eiderdown is collected from the nests twice each season. The first collection is made at about the mid-point of the incubation period. At that time the collector carefully plucks a few handfuls from the inside of the nest and from beneath the eggs. Enough down to envelop the eggs is left in the nest. After the young eiders have hatched and been led to the sea, all the down remaining in the nests is collected. The first collection of down commands a better price than that taken at the end of the season because it is usually cleaner and has not been subjected to the trampling of the young ducks.

A number of different methods of habitat improvement were seen. The most commonly employed was the construction of nest scrapes and shelters. At Myrar, for example, there was a series of hard-packed gravel ridges on which the eiders had been prevented from nesting because they could not scrape out the slight depression which must form the nest base. There, a farmer, Gisli Vagnsson, had dug rows of little saucer-like hollows and most of them were occupied by eider nests. At Lón, near Saudarkrokur, flat rocks were employed to build a terrace of stalls enclosed on three sides and covered on the top. Some of these too had eider ducks as tenants. Besides sheltering the birds, they stopped the wind from scattering valuable down.

Myrar was the most intensively managed colony we saw, perhaps because its site was naturally less suitable than many others. Between the gravel ridges, where nest scrapes were constructed, were damp, grassy swales. Nests built in such locations require special care. At the time of the first down collection the nests are examined closely and if they are at all damp they are built up from below by the insertion of dry hay under the eggs and down.

The eider's principal natural enemies are great black-backed gulls and ravens. Both species relish eider eggs and the former also preys on the downy young. The principal method of control is the placing of poisoned baits early in the spring. Strychnine is injected into hen's eggs and these are set out around the colonies, before the eider's eggs have been laid. Considerable success results from this method of control.

As soon as the Icelanders gather eiderdown, they set it out to dry in the sun, if the weather is fine. After the down has been thoroughly dried, it may be bagged and stored although

it is best to complete the cleaning process as soon as possible. Materials which must be removed from the down include dirt, excreta, feathers and bits of grass and twigs. Like most wild creatures, eider ducks have their own complement of ectoparasites, and thus the down may often be infested with lice. Although the lice will eventually leave the down of their own accord or be killed by the cleaning process, their demise can be hastened by sprinkling the down with powdered DDT, a practice recently adopted by many Icelandic farmers.

Even though Icelanders have led the way in the development of modern techniques for cleaning eiderdown, the old fashioned method is still followed by some farmers there. Baldur Bjarnsson was such a one. When he was ready to clean the down collected on his farm he heated it in an old enamel-ware saucepan on the stove and then, slowly and laboriously, several handfuls at a time, placed it on a rectangular frame like a window sash on which string was stretched in parallel lines from top to bottom and rubbed it through the strings with a thin, elliptical wooden tool. By that method a man can clean two or three kilograms a day.

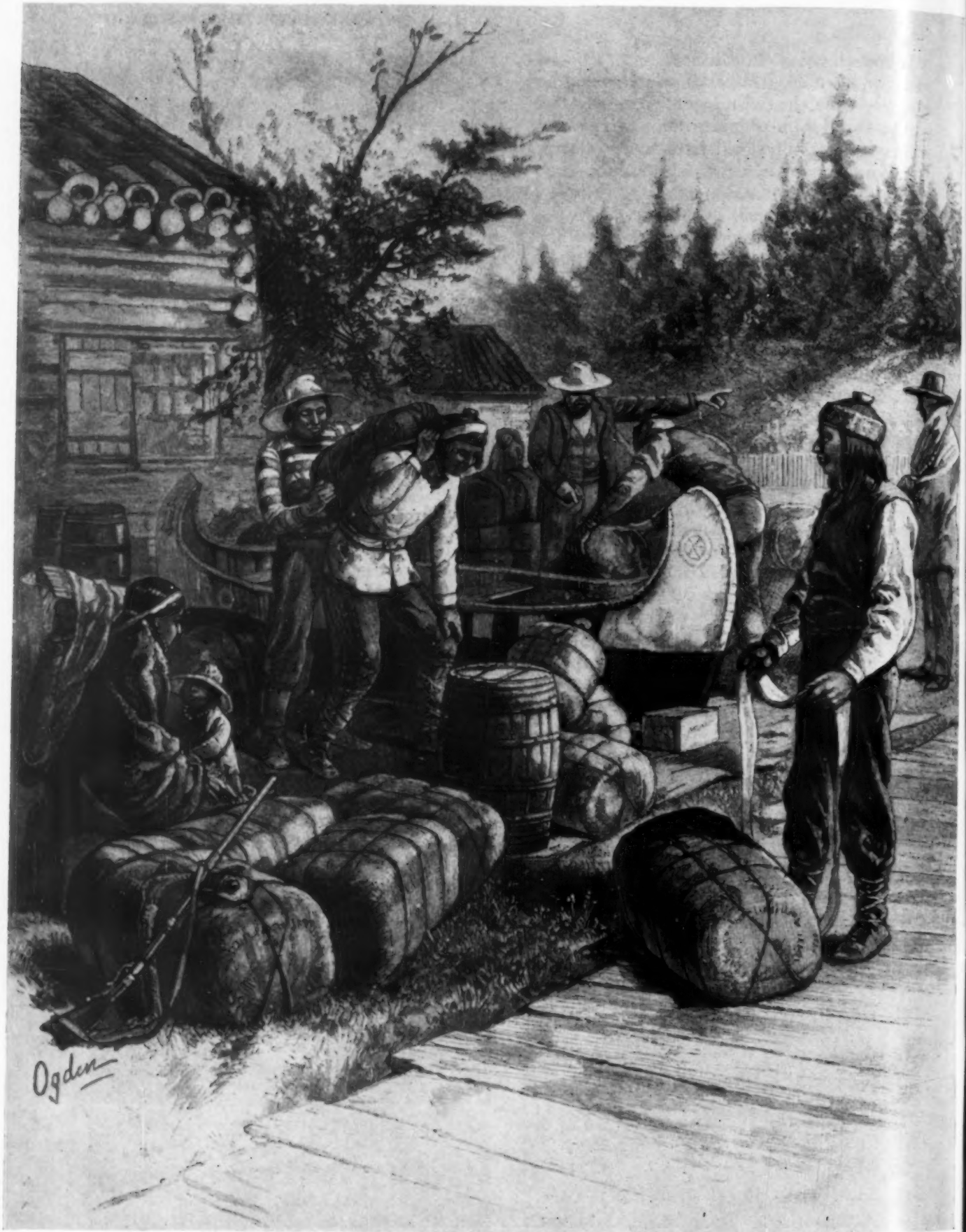
In the Farmers' Co-operative at Akureyri we saw a more modern means of cleaning down. There in a dusty loft was a long narrow machine which was in effect, simply a mechanized and enlarged version of Baldur's string board. Machine-driven wooden fingers stroked the down through a long, narrow lattice of cord strung on a metal frame. We were told that the scattering of down in the air resulting from the operation of the machine was so unpleasant that it was difficult to get people to work there.

However, Baldwin Johnsson of Reykjavik is the eider farmers' hero. He has invented an enclosed cleaning machine, with some of the characteristics of an automatic clothes dryer, which can clean a kilogram of down in less than an hour. His invention has been so successful that several of his machines have been exported to Canada.

The term "eiderdown" has been somewhat corrupted by use to designate any kind of waterfowl down, sometimes even such ignoble substitutes as chopped chicken feathers. Genuine eiderdown, however, is unique. Its marvelous qualities of self-adhesion are such that it can be used in a bed-sized coverlet without quilting. The traveller who stays at Reykjavik's Hotel Borg, or in any Icelandic home, will soon come to appreciate the luxury of sleeping beneath a genuine eiderdown robe. In these days of synthetic substitutes there may never be a mass market for eiderdown, but so long as there are people who appreciate a natural product of high quality, the eider farms of Iceland will doubtless prosper.

An eider duck on her nest.

An eider with her clutch of eggs.



Unloading a North canoe at the trading post. Sketch published in **Picturesque Canada**, *Toronto, 1802.*
Public Archives of Canada

Voyageurs' Highway

The Canadian Fur Trade: Its Logistics, and Contribution to Canadian Development

by ERIC W. MORSE

This is the third of a series of three articles about the geography of the fur trade routes of Canada.

NEXT TO the difficulties faced by the voyageurs, perhaps the most impressive feature of the Canadian fur trade was its spread, the vast canvas, not merely continental but hemispheric, against which it was painted.

Alexander Mackenzie, looking for a closer sea-outlet for Athabasca furs, at two strokes carried the empire of the North West Company to the Arctic and Pacific Oceans. Fraser added the valley that bears his name, plus the district north of the Fraser's big bend which was nostalgically named New Caledonia. David Thompson's explorations added to the territories of the North West Company the whole transmontane area grouped about the valleys of the Columbia, the Kootenay, the Okanagan, and the Thompson. After the merger in 1821, the Hudson's Bay Company therefore held an area which slightly overspread Canada's modern boundaries. From Labrador north along Hudson's Bay and even up near the remote mouth of the Mackenzie, the Company's sway extended to the Pacific, and as far south as the mouth of the Columbia.

This half-continent was inhabited by native tribes in the process of passing out of the stone and copper ages. They had an insatiable demand for the white man's manufactured goods. A complete list of articles used in the Canadian fur trade was a formidable catalogue running into literally hundreds of items. Apart from his need for superior weapons with which to overcome his enemies, the Indian wanted hunting equipment: guns, traps, knives, ice-chisels, axes, hooks, ammunition and flints. Primitive deerskin might be satisfactory covering in the dry, cold winter, but skins were not the thing to wear in wet weather. The demand for woollen clothing, strouds and blankets, was therefore great. The squaws, happy to get away from cooking by the ancient method of dropping red-hot stones into water, wanted metal cooking vessels and utensils. They also welcomed having something better than a bone to sew with; they needed needles, awls, and thread. As Daniel Harmon wrote: "The Indians in this quarter have been so long accustomed to use European goods that it would be with difficulty that they could now obtain a livelihood without them." Finally, there were "firewater", tobacco, and beads.

The fur trade linked the Indian's primitive economy with that of the most industrialized civilization in the world. Europe demanded ladies' fine furs, such as mink, marten, lynx, fox, and ermine—and even utility furs such as bear and wolf. But the heavy, long-term demand was based on the hat trade's need for *beaver*. Beaver hair, being microscopically barbed, was valued in felting. A beaver hat was not a Davy Crockett affair, but a superior, glossy felt article, shaped according to the vogue—flat, stove-pipe, tricorne. Samuel Pepys recorded paying £4 for a beaver hat in a decade when a top architect such as Christopher Wren earned £200 a year. A firm and continuing market for beaver was the principal driving force behind the fur trade of Canada. Only a commodity of such concentrated value could support the cost of transcontinental transport.

Into the two ports of Montreal and York Factory therefore came ships bearing many kinds of trading goods. The manufactured goods (both hardware and cloth) would be chiefly from England, the country most advanced industrially. From Italy would come beads and trinkets. France would contribute "high wine" (brandy). From the West Indies would come a tributary stream of rum. In its ultimate stages the Canadian fur trade even included a triangular commerce bridging both the Atlantic and Pacific Oceans: Pacific furs like the sea otter were taken from the Colum-

bia mouth to China, the ships then loading with tea and returning to England to exchange it for a new cargo of trading goods for the Columbia.

The Logistics of the Trade

It is not, however, as much with the international aspects of the trade that we are concerned here, as with the problem of getting the trading goods from the seaports into the fur country, and the furs out. Because of vast distances, primitive communications and formidable physical difficulties, this called for a high degree of organizing and ingenuity.

In the early days of the fur trade in the seventeenth century, there was no serious problem. The Hudson's Bay Company simply sat on the shores of the Bay and let the Indians come to them. The neighbouring, or "home" Indians, the Swampy Crees, served as middlemen, charging the more distant tribes a proportionate mark-up. Even Montreal for a short time held its great annual trade-fair; and such tribes as the Ottawas, the Nipissings and the Hurons served as middlemen to the more remote eastern tribes. Montreal's problem of gathering its furs, however, soon became serious, as a result of the Iroquois wars and the extermination of the beaver near at hand. The fur traders then had to go farther and farther afield. As they did so, questions of financing and organization became increasingly more important.

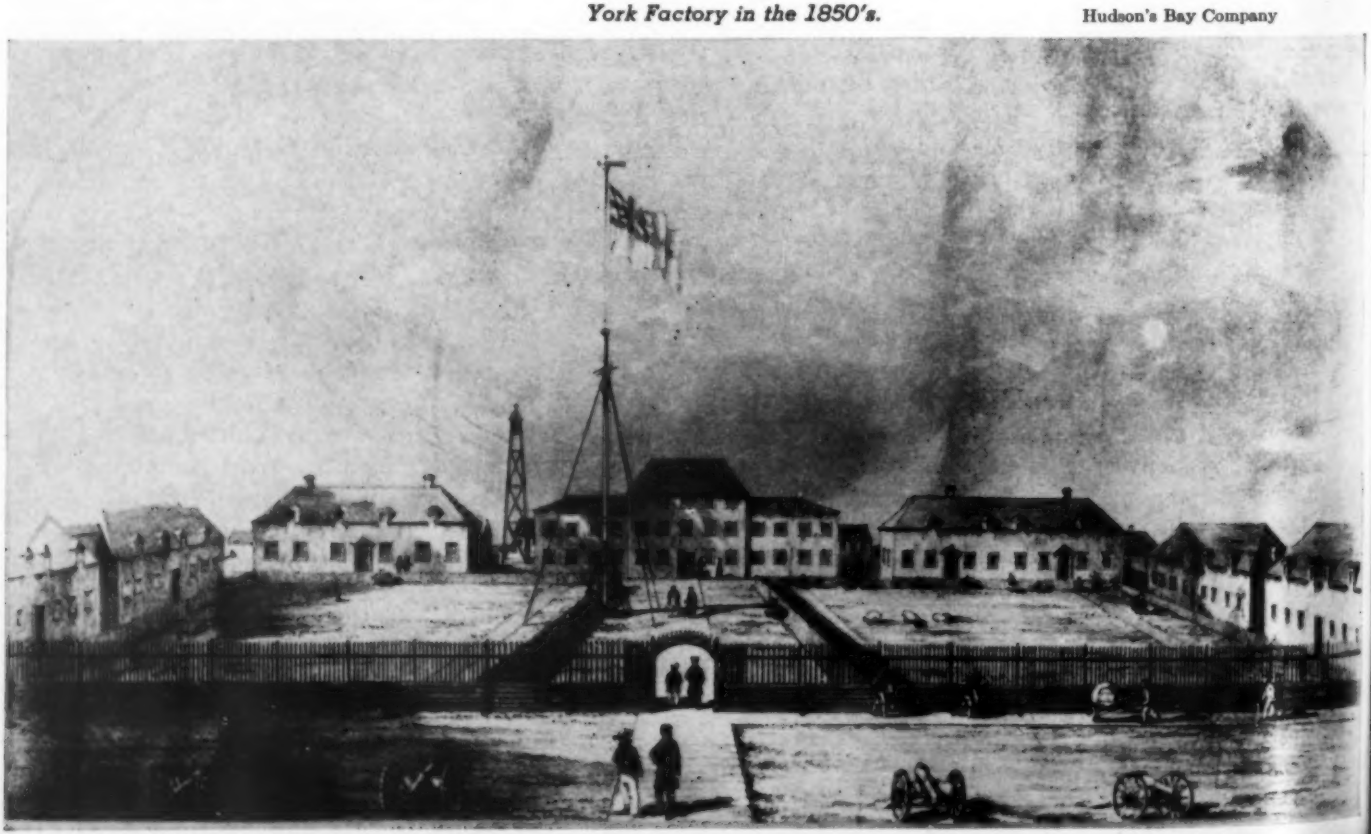
The Montreal fur traders, of course, faced a much greater problem than did their Hudson's Bay Company rivals. A few times—e.g. Kelsey in 1690, Henday in 1754—the Honourable Company did send out men to drum up trade; but things were pretty easy for the Company until it was forced to go inland and meet the Montreal competition. Cumberland House, the first H.B.C. inland post, was not established till 1774.

By the time Peter Pond discovered the Methye Portage in 1778, the North West Company territories had reached continental proportions. The movement of its trading goods and furs presented, in particular, three logistic problems: 1. Means of communication. 2. Motive power. 3. Fuel supply. One other difficulty, never adequately solved by the North Westers, but finally overcome after union was: 4. Crossing the Rockies.

1. Means of Communication

The North West Company's main line of communication, 3,000 miles long, crossed a vast forest laced with turbulent rivers and dotted with thousands of lakes. There were no roads nor railways. Dog teams are of no use for heavy traffic. The only way was some form of water communication. But the problem was complicated by two hard facts: (a)

York Factory in the 1850's. Hudson's Bay Company



First sale of Hudson's Bay Company furs in London, at Garraway's Coffee-House, 1671.
Hudson's Bay Company

there were only five months between break-up and freeze-up; (b) craft adapted to the big waters of the eastern half of the journey were useless for the small lakes and rapids of the western half—and vice versa.

The solution, as has been outlined earlier, was to have two sets of different-sized canoes, "canots de maîtres" and North canoes, starting in May from opposite ends, meeting in the middle, exchanging their loads and returning to their points of origin by late September. All this involved a high degree of organization at the central entrepot: docks and warehouses at both ends of the Grand Portage, re-sorting and packaging of the "pièces" for the various inland posts, strings of sweating voyageurs crossing the nine-mile portage path. (They were required in their contract to carry a total of six "pièces" each way, and were paid extra above this total.) Repair facilities at both ends of the portage were needed to make the two sets of canoes seaworthy for their tough, two-months' journey home. A special detachment had to be sent from Grand Portage to Fort Frances to give the farthest brigades a headstart back to race the frost. On the Kaministikwia route, the lower rapids, all the way below Kakabeka Falls, were so shallow that a special depot was established at the Falls (Mountain Portage) where the provisions were loaded for the first leg of their western voyage.

From mid-July to mid-August, Grand Portage and later Fort William became the brain-centre of the trade. It was here that the wintering partners (the "hivernants") from the northern posts met the agents and partners from Montreal. Meeting in council, they decided every detail of the trade's requirements: personnel, rotation, promotion, prices and dividends.

The Hudson's Bay Company, with headquarters in London, needed no main nerve-centre in Canada; but Norway House fulfilled for the Hudson's Bay Company the corresponding function of central entrepot for re-distribution of goods from York Factory—south to Fort Garry and west to Cumberland House—and also served as a collecting point for the outgoing furs.

In this system of communications there were, for both Companies, express canoes bearing mail and messages—such as, for example, news of any shift in demand in the fur market. The winter express used dog teams and even Indian couriers.

Before leaving the question of communications, an interesting postcript is that the

Canot, N°. 25

2735

N. W.		
	19	Ballots de Marchandises, No,
		ℰ 1. 11. 12. 6. 13. 15. 7. 16. 8. 10.
		ℱ 33. 36. 14. 12. 38. 66. 11. 43.
		15.
	1	Ballots de Tabac noir,
		- - - - de Tabac en carotes,
		- - - - de N. W. Twist,
		- - - - de Chaudières évasées,
		- - - - de Chaudières de cuivre,
		- - - - de Chaudières de fer blanc,
	1	- - - - de Jambons,
		- - - - de Bajoux,
		Barils de Sel,
		- - - de Graisse,
	2	- - - de Poudre,
		- - - de Sucre blanc,
		- - - de Sucre brun,
	1 4	- - - de Lard,
	20	- - - de High Wines,
		- - - de Rum,
		- - - d'Esprit,
	1 2	- - - de Bœuf,
	1 2	- - - de Beurre,
	1 2	- - - de Shrub,
	1 1	- - - de Vin de Port,
		- - - de Vin de Madère,
		- - - de Vin rouge,
		- - - d'Eau de vie de France,
		- - - de Langues,
		- - - de Saucisses,
		- - - d'Orge,
		- - - de Riz,
		- - - de Fromage,
		- - - de Raisins,
		- - - de Figues,
		- - - de Prunes,
	2	Cassettes de Marchandises, No. W 246,
	2	Caisses de Fer, No. W 11. P. 255
	1	- - - - de Chapeaux, No. W 174.
		- - - - de Couteaux, No.
		- - - - de Fusils,
	1	- - - - de Pièges, ℱ 57.
		- - - - de Savon,
	1	Maccarons de High Wines,
		- - - - - d'Esprit,
		- - - - - de Rum,
		- - - - - Mêlés,
		Paquets de Fer,
		- - - - d'Acier,
	1	Sacs de Plomb,
	1	- - - de Balles,
		- - - de Pois,
		- - - de Bled d'Inde d'1¼ minot,
		- - - ——————— de 2 minots,
	1	Canot

Les noms des hommes, savoir :

Amable Lauzelle D
Jos. Le Jeune — E
Michel Cuillerier — F
Antoine Le Jeune d
Jos. A. La Fontaine do
Jos. Mathieu — do
J B.te Bellerose do
J B.te Chevrier do
Jacques Jourdain do

Vivres, savoir :

8 Sacs de Biscuits,
2 - - - de Pois,
200 livres de Lard,

Les Agres, savoir :

1 Hache,
1 Plat de fer blanc,
1 Voile,
2 Pré'ats,
5 Lignes de Banc,
1 Chaudière,
1 Alêne,
1 rouleau d'Ecorce,
6 bottes de Wattap,
1 Crémaillière,
12 à 18 livres de Gomme.

19 Pièces.

La Chine, 6 Mai 1802.

Photograph of a North West Company canoe bill of lading dated at Lachine, 6 May 1802. (It should be noted that the delicacies listed on the left, such as ham, butter, and port, were not for the common voyageurs.)

McCord Museum, McGill University

Hudson's Bay Company eventually came to employ the same basic tactic to cross the thirteen-mile Methye Portage that the North West Company had earlier used over the Grand Portage, namely, two separate sets of boats, from the Mackenzie River and from Norway House, making rendezvous at the portage. This saved portaging the boats themselves. On the Methye, the rendezvous was the little lake four miles from the north end of the portage.

2. Motive Power

The outboard motor for the fur canoe was the Canadian voyageur, without whom the fur trade would have been patently impossible. He was incredibly durable, always cheerful and tractable. Jacob Astor said he would prefer to have one Canadian voyageur to three of any other breed. The voyageurs were recruited on the banks of the St. Lawrence, particularly around Trois Rivières and Montreal. In a dull, authoritarian society, yet where men were reared on the traditions and tall tales of the "pays d'en haut", the fur companies had no trouble in recruiting all the "engagés" they required. The voyageurs made no money; the lure was adventure and escape.

These were usually small men (their Scots masters had an eye to every extra pound of furs that could be squeezed into the canoe). Every Canadian is familiar with the tough, gay, insouciant picture the voyageur presented, with a feather stuck in his cap and a bright sash or "ceinture fléchée". The French *chansons* to which they paddled, "A la Claire Fontaine", "C'est l'Aviron", "En Roulant ma Boule", "Youpe Youpe sur la Rivière", etc., gave rhythm and momentum to their stroke, the sort of function played by sea-shanties for seamen in the sailing age. The voyageur, in fact, was sometimes paid a bonus for his singing voice.

But it is more strictly of the voyageur as a motor that we are speaking. It was his function to paddle the canoe and to carry the goods over the portage. And it is here that a purist would voice a distinction between two loosely-used terms. The coureur de bois, travelling on his own all year, often living with, or as, the Indians, also had to paddle and to carry. But there is with the coureur de bois an independent and commercial connotation. He traded. The voyageur merely packed and paddled for his master, a trading concern.

The first logistic fact of the line of communication was that the furs and trading goods would be constantly in and out of the canoes. When therefore the goods arrived at Montreal (and York Factory) by ship from Europe they were packaged into "pièces" of ninety pounds. The furs were similarly packaged. This weight is about all that a man is happy to fling around, especially onto his neck. A big Montreal canoe carried about sixty "pièces" which—plus the men's personal ditty bags (limited as on modern airplanes to 40 lb.)—totalled three tons, plus or minus. A North canoe carried half this, or about twenty-five "pièces".

The journey by freight canoe between Montreal and Grand Portage, depending on the wind, took from six to eight weeks. The fastest freight trip from Grand Portage to Fort Chipewyan, Alexander Mackenzie records, was fifty-two days, although usually two months were allowed. The critical area for ice both in spring and fall was the two big lakes immediately south of Methye Portage, Peter Pond Lake and Lac La Loche. Delay in break-up and the danger of freeze-up put constant pressure on the voyageurs. Winter was always breathing down their necks.

Haste is borne out in their daily routine. After not more than four or five hours' sleep, they rose to the cry, "Leve, leve", as early as three a.m.—or even an hour earlier if they were behind schedule and there were no rapids to be run at once. Then followed two or three hours' paddling before breakfast. The motors were allowed to idle five or ten minutes every hour throughout the day, as the men pulled out their long clay pipes and lit up. The hourly break, in fact, came to be known as a "pipe". The voyageurs even measured distance in this way, calling the fifteen or eighteen miles they would paddle in three hours, for example, a distance of "trois pipes". On the road (unless it was particularly tough going) only a light lunch was "served". But they made up, in quantity at least, by having a good breakfast and supper. Supper might not be till nine or ten at night, after which they retired, heads under the canoe, and with neither air-mattress nor even protection

against the mosquitoes. After a particularly rough spot, or as a celebration, the bourgeois would order the men to be given a dram. Each crew on leaving Lachine or Grand Portage was usually given a keg of rum. However, one gets the impression that the improvident voyageurs regarded the keg as a heavy and awkward object for portaging, and there was a certain spot early in the voyage, hallowed by tradition, where the keg was killed.

Sail boats, pack horses, and Red River carts came to be used later for special sections of the course, but basically the motive power for the fur trade remained the voyageur, without whose skill and durability the fur trade in those days could not have been carried on.

3. Fuel Supply

Using only human engines and with a thinly inhabited wilderness to cross, the North West Company faced one of its biggest logistic problems in refuelling, finding food along the way. Even a "canot de maître" was capable of carrying only so much tonnage. It was all very well for a coureur de bois, a hunter or an explorer to live off the land, but in the mad rush of the voyageurs' eighteen-hour day, there was no time for hunting.

Men in harness "tracking", or lining, barges up the Athabasca River. Canoes in the earlier part of the last century had to be taken upstream similarly.
Ernest Brown Collection, Edmonton

On the road, the kind of food used was geared to the particular part of the country, and always to the criterion of weight. At Montreal the big canoes were loaded with enough to last for the four or five weeks' journey to Michilimackinac or the Soo. The ration consisted of dried peas or beans, pork, and sea-biscuit. Since they were starting from a seaport, near farm-land, this was the least difficult section for provisioning.

At Michilimackinac the canoes took on dry, leached corn which had been pounded into a sort of hominy, to be mixed with pork fat or bear's grease. A quart per man was dished out as the daily ration. To have corn always obtainable at Michilimackinac required some organizing by the Company. Indians in nearby areas were commissioned to grow it and bring it in for trade, in lieu of furs. Corn was grown also around Detroit and Niagara and shipped up the lake.

West of Lake Superior, reprovisioning was more complicated, for there were no farms. Between Grand Portage and Lake Winnipeg, the diet depended on which way the voyageur was heading. If westward, it would be cornmush, but perhaps supplemented occasionally in that country with wild rice, and even, rarely, touched up with some maple syrup. If he had just come across the prairies and was heading eastward, his diet staple was the same as that used on the prairies.

Here we encounter another fur-trade indispensable, pemmican. It was Peter Pond who first realized the essential value to his Company of this Indian commodity; and both the North West Company and Hudson's Bay Company organized its production among the Indians. Pemmican was sun-dried, pounded buffalo (or moose) meat, perhaps with saskatoon berries added, packed into ninety-pound bags with melted beef tallow poured over it. Kept dry, it could last for months. It was a concentrated and highly nutritious food, and three or four pounds was a man's daily ration. It was either sliced off to nibble on the way, or by the addition of flour and water it was made up into a thick soup or stew, called "rubbaboo". The pemmican of the Red and Assiniboine valleys went to Bas de la Rivière (later Fort Alexander) at the mouth of the Winnipeg. The Saskatchewan-valley pemmican was collected at Cumberland House. That

A line of Red River carts carrying $75,000 worth of furs over the portage leaving Fort Smith on the Slave River
Ernest Brown Collection, Edmonton

from the Beaver valley was brought in to Ile à la Crosse. These three posts were the refuelling stations for the western section of the route. Some idea of the total quantity required is recorded in an entry of Alexander Henry's in his Journal, for September 13, 1809: "At 4 p.m. I arrived at Fort Vermillion (east of Edmonton) having been two months on my way from Fort William. . . . Our expenditure of provisions for *each* (six-man) canoe during this voyage was: two bags of corn 1½ bushels each and 15 lbs. of grease, to (Rainy Lake); two bags of wild rice, 1½ bushels each, and 10 lbs. of grease to Bas de la Riviere Winipic; four bags of pemmican, 90 lbs. each to Cumberland House. . . . Those brigades which proceed N.W. of Cumberland House require three additional bags of pemmican per canoe, and some a fourth."

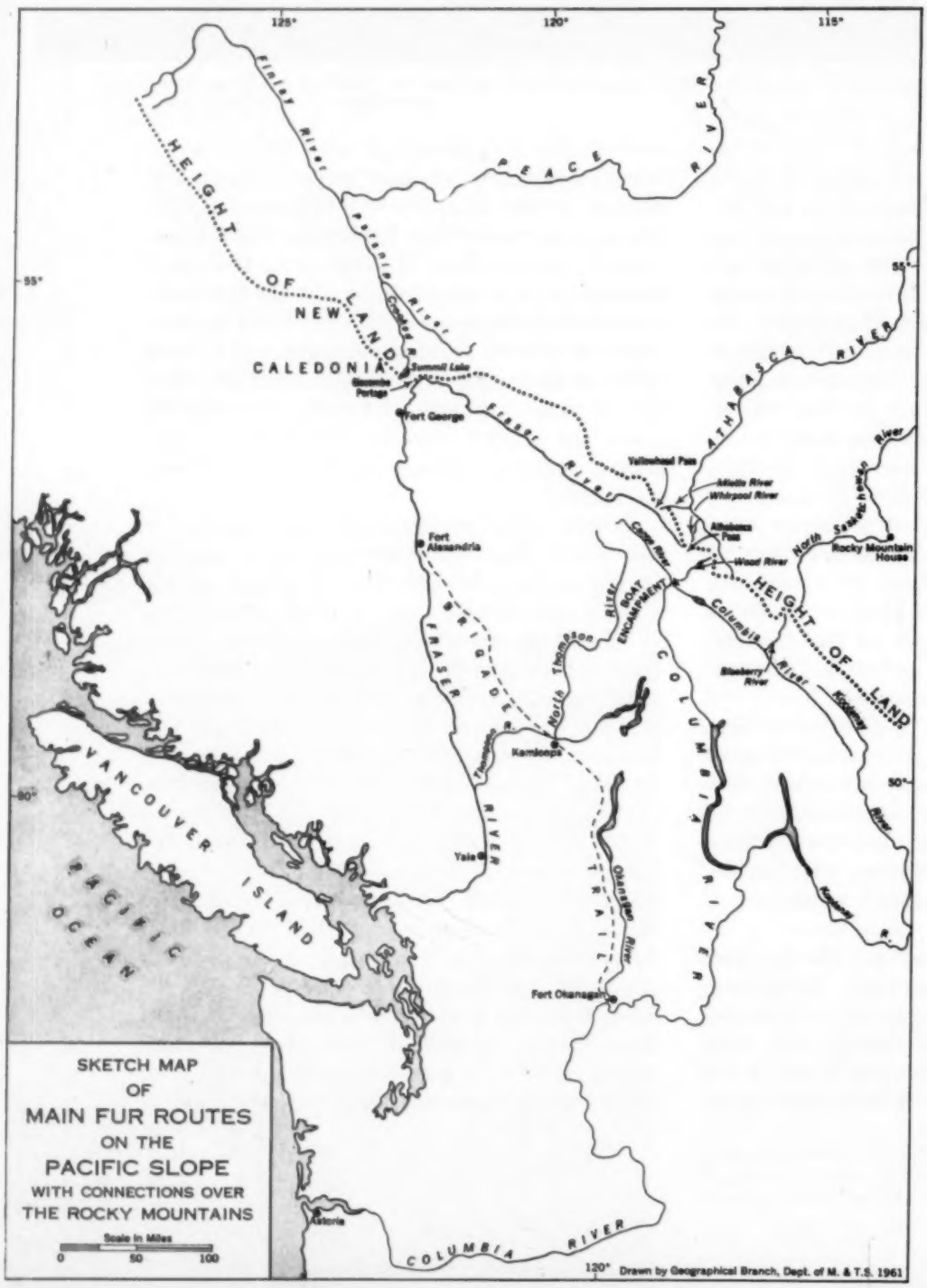
Heading back eastward in the spring from Fort Chipewyan, the voyageur had to content himself with what had been his staple diet all winter, fish; but since it was whitefish, he probably didn't suffer. When the trade shifted across the Rockies, the fuel there while on the road was chiefly pemmican and salmon.

4. Crossing the Rockies

Bringing in the area beyond the Rockies posed serious questions of supply. There were two separate fur districts, the *Columbia Valley* (including the Kootenay) and *New Caledonia* (just north of the big bend of the Fraser River). The furs of New Caledonia were particularly choice; in fact, the black beaver of that country was regarded as the best in the trade. The 3,000-mile transcontinental route to Fort Chipewyan in the navigation season available was already far overextended. Quite apart from the purely quantitative matter of tacking on another thousand miles to this communication line, there was the cardinal problem of finding a navigable route for freight canoes. The Rockies presented gradients found nowhere east of the mountains.

Several abortive attempts were made by the North West Company to find a feasible freight route through the Rockies to the Pacific: Mackenzie's try in 1793, Fraser's in 1808, and several efforts of David Thompson's leading from the North Saskatchewan River. Mackenzie and Fraser did show that it was possible to pierce the main ridge of the Rockies by way of the Peace, Parsnip and Crooked Rivers, over to the Fraser bend. But the Fraser gorge, from Fort Alexandria to Yale, proved to be out of the question for freight canoes. Thompson failed to find a practicable route for heavy traffic over the spine of the Rockies at any point south of the Fraser bend. He eventually managed to crash through from the source of the North Saskatchewan to the Columbia via the Blaeberry River, but (like Fraser's descent of the Fraser River) it was a miracle of survival, even without carrying heavy goods.

Thompson finally fell back on a route (possibly first found by Duncan M'Gillivray) by way of Athabasca Pass. It was not an all-canoe route, but a combination of canoe, horse, and foot-packing. Instead of continuing on the North Saskatchewan River past Edmonton, the Columbia brigades would cross to Athabasca Landing, ninety miles to the north. They then went by canoe up the Athabasca River. Soon after passing Jasper they left the Athabasca and went up one of its tributaries, a steep, rocky stream, the present Whirlpool River, to its source at Athabasca Pass. Here they abandoned their canoes, took to pack horses, and after crossing the pass (at 6,000 feet) they dropped steeply for 4,000 feet beside the Wood River to Boat Encampment, between the mouths of the Wood and Canoe Rivers, at the Columbia's Big Bend. A new set of canoes there awaited them for the journey to the sea. Returning in the spring they reversed the process—except that now the snow still lay around on the upper reaches of the pass, so instead of horses the men had to pack on foot or snowshoes carrying 100 pounds up the steep mountain "trail".[1] Simpson returned by this route in 1825. It was the most gruelling ordeal across the whole transcontinental route, and obviously was no permanent solution to the problem of crossing the Rockies. At best it could take care of a portion of the Columbia Valley trade, which it did till 1826. It was useless for New Caledonia.



In 1813, John Stuart set out from New Caledonia and discovered a new route, a pack-horse trail linking Mackenzie's explorations with Thompson's. From what later became Fort Alexandria (near Mackenzie's turning point on the Fraser, and above which the river is navigable) the route crossed a mountain range to Kamloops, and thence went down along the west side of the Okanagan Lakes to Fort Okanagan, where the Okanagan joins the main Columbia River; from here down to the sea there was no serious navigational obstacle and canoes were used.

[1] See the excellent reconstruction by R. M. Patterson written up in the Winter issue of the *Beaver*, 1960, "We Clomb the Pathless Pass".

A recent photograph showing the Grand Batture of the Whirlpool River looking southwest near the Athabasca Pass.

Raymond M. Patterson

In 1813, Astoria, at the mouth of the Columbia, had just fallen to the North West Company, and the *Isaac Todd* had made its initial trip from England around the Horn bringing trading goods to the Columbia's mouth.

The period from 1813 to 1826 was a confused one—including the end of the war, the final, bitterest phase of the inter-company struggle, and the beginning of Simpson's management of the merged concern. During this period, New Caledonia was supplied with goods by way of the sea, but continued to ship its furs out eastward by the Peace River to Fort Chipewyan. In 1826, by which time Simpson had at last been able to shift his attention to the western limits of his empire, the sea approach from the mouth of the Columbia was regularized, and the Okanagan—Kamloops—Fort Alexandria brigade route became the avenue used both in and out.

This brigade route was subsequently modified—in 1842 to allow for Fort Kamloops being transferred to the west side of the North Thompson; and again in 1847, after the Oregon Treaty necessitated going from Kamloops south-west and over to the lower Fraser, in order to remain on Canadian soil. Finally, after the gold rush, the Cariboo Trail was adopted instead.

The ultimate and sensible solution to the colossal problem of crossing the Rockies was therefore not to cross them at all—except in express canoes with mail and messages. These used both the Peace River route and the Yellowhead Pass route from Jasper over to the North Thompson.

The Fur Trade's Contribution to the Development of Canada

The existence of Canada as a separate nation was determined, in 1774, when the concessions made by Britain to the newly-conquered French in the Quebec Act helped to

A Hudson's Bay Company fur brigade passing Okanagan Lake in British Columbia. This painting by John Innes is on permanent loan to the Pacific National Exhibition and is reproduced here by the courtesy of the Native Sons of British Columbia.

convince Quebec that they should resist American blandishments to become the fourteenth colony. It was the wealth and influence of the fur magnates in both Montreal and London that were responsible for Britain's making these surprising concessions, which in turn ensured that Quebec would remain the core of a new British nation in North America.

The exploration of Canada, and the fact that the nation today does not terminate at Windsor—or Lakehead, or Winnipeg, or Calgary—are almost entirely by-products of the fur-trade. A quaint Victorian assumption colours some of our earlier history books, equating the exploration of Canada somehow with the spread of the Empire or the spread of the gospel; but this hardly deserves serious notice today. Canadian exploration has been sometimes represented also as a romantic "search for the western sea"; and this may have confused generations of Canadian schoolchildren into thinking of Canada's mainland explorers in terms of Balboa or the searchers for the Northwest Passage, always looking for something, not at hand, but beyond. This approach among most historians seems fortunately at last to have given way to a purely economic interpretation, that Canadian exploration and the fur trade are practically one and the same thing. Every important Canadian explorer (not discoverer)—Brulé, La-Salle, Radisson, Groseilliers, Kelsey, Henday, Mackenzie, Fraser, Thompson—was a full-time fur-trader. Champlain was head of a fur-trading company. La Vérendrye had fixed ideas about a western sea, but he had to be 'grub-staked' by a group of Montreal fur-traders. Hearne, though searching for copper, was an employee of the Hudson's Bay Company; and also were Fidler, Turnor, Bell, Black, and Campbell.

The beaver by its defencelessness contributed to its own early extermination in nearer areas, and by its value led men ever westward and northward. The fur trade unrolled the map of Canada.

The fur trade, early in Canadian history, established east-west thinking. The Voyageurs' Highway was the certain precursor of the "bands of steel" which later bound

Canada as a nation. The fur trade thus stopped "Manifest Destiny" at the border; and long before confederation, it ensured that the foundations of Canada as a nation had been securely laid.

The fur trade played a principal role in various negotiations determining Canada's boundaries. The international boundary from Lake Superior to Lake of the Woods is defined in the treaty simply as the "customary waterway" of the voyageurs. The fur trade determined also the international boundary from the crest of the Rockies to the Pacific. As Harold Innis states in his *The Fur Trade in Canada:* "It is no mere accident that the present Dominion coincides roughly with the fur-trading areas of northern North America."

It is worthy of note that throughout the million and a half square miles bought by Canada from the Hudson's Bay Company in 1870 there were law and peaceful relations with the Indians. Whereas, across the border, too tragically often the Indians were regarded as vermin, to be removed with the wolves and trees to make way for settlement, in Canada the fur trade had ensured on the whole a tradition of trust and rapport between the races. This in turn—and despite the temporary troubles with the Métis—made an important contribution eventually to the settlement of the Canadian West.

Finally (though hardly to be regarded as a factor in Canada's actual development) we have as another heritage of the fur trade a chain of charming French names, stretching across even Ontario and the Prairie Provinces. Mingled with prosaic English names like Mud Lake, we see on the map along the Voyageurs' Highway and its approaches such words as Cache Bay, Maligne River, Rapide Qui Ne Parle Point, Grand Marais, Isle Royale, Presqu'ile, Miette, Sault Ste. Marie, La Ronge, Brulé, Detroit, and Qu'Appelle. Such voyageur terms as "portage", "traverse", and "prairie", met in local names all across the old canoe route, are always a vivid reminder of a period of Canadian history of which the romance never dies.

The fishing industry was responsible for discovering Canada. Lumbering and mining dominate our modern economy. But in the formative years from 1600 to 1800, spanning both the French and early English regimes, Canada's principal moulding influence was the fur trade. Some other nations owe their development to diamonds, or gold, or teak. Canada is a nation built on fur. The beaver, with reason, holds a place just below the crown in our national symbolism and heraldry.

Perhaps, when we get around to that distinctive Canadian flag, someone will find a place on it for a birch tree—or even a voyageur.

A trapper arriving at a Hudson's Bay Company post with his catch of furs.
R. Harrington, for the Hudson's Bay Company

THE GEOLOGY OF THE ARCTIC

Proceedings of the First International Symposium on Arctic Geology

Edited by Gilbert O. Raasch

The publication of the proceedings of this Symposium on the Arctic represents the first concerted effort to issue a comprehensive volume in the field. Over 1,100 geologists from all circumpolar countries attended the Symposium and nearly 100 papers were presented. The published proceedings include most of the papers read, with attendant maps, charts, and plates. Notable are four papers by outstanding Russian geologists, a lengthy symposium on Greenland, and several papers on the Canadian Arctic Archipelago.

While the programme included subjects ranging from Precambrian to Recent, particular stress was placed on the fields of post-Precambrian stratigraphy and structure. No doubt The Geology of the Arctic will be the standard reference on Arctic geology for many years to come.

Contents: REGIONAL GEOLOGY: Soviet Arctic, Spitzbergen, Greenland, Canada, Alaska, Arctic Ocean Basin.

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UNIVERSITY OF TORONTO PRESS 1,230 pages (2 vols.) chart case 6¾ x 9¾ inches illustrated $25.50

EDITOR'S NOTE-BOOK

J. R. Lotz (*Operation Hazen*) obtained his B.A. in geography from Manchester University in 1952 and for a year was employed as a trader with the United Africa Company in Nigeria. For his rescue work during the Kano riots in 1953, he was awarded the Queen's Commendation for Bravery. In 1954, Mr. Lotz came to Canada, and obtained his M.Sc. in geography from McGill University in 1957. During his studies he did field work with the McGill Subarctic Research Laboratory at Schefferville in Quebec. In addition to serving as meteorologist in the Canadian expedition "Operation Hazen" during 1957-58, he has served as Research Scientist with the Arctic Institute of North America from 1959-60, with the United States Ellesmere Island Ice Shelf Project in the summer of 1959, and as Scientific Officer with the Defence Research Board in 1960. He is now Community Planning Officer with the Industrial Division of the Department of Northern Affairs in Ottawa.

* * *

John P. Ough (*Sport Fishing Near the Arctic Circle*) is on the staff of the Editorial and Information Division of the Department of Mines and Technical Surveys in Ottawa. He was born in London, England, and after serving in the Second World War as a fighter pilot with the Air Branch of the Royal Navy, did extensive hydrographic and land survey work not only in England but also in the Persian Gulf and in India. Mr. Ough joined the Canadian Hydrographic Service in 1953 and spent five seasons in the Arctic on hydrographic surveys. He assumed his present position in 1959.

* * *

David A. Munro (*The Eider Farms of Iceland*) is a native of Vernon, British Columbia. He obtained his B.A. in zoology from the University of British Columbia in 1947 and his Ph.D. from the University of Toronto in 1956, undertaking studies in zoology and land utilization. Since 1948, he has been with the Canadian Wildlife Service, first as Wildlife Management Officer, Vancouver area, until 1953, when he was appointed Chief Ornithologist. His major field projects have included, as well as the investigation of eider farming in Iceland, depredation investigations in southern Saskatchewan, a study of Canada geese in southeastern British Columbia, and a study of caribou in Arctic Alaska and the Yukon. Mr. Munro has published numerous reports and articles in various wildlife publications.

* * *

Eric W. Morse (*Voyageurs' Highway*), see biographical sketch in the C.G.J. for May 1961.

AMONGST THE NEW BOOKS

The Atmosphere and the Sea In Motion

Edited by Bert Bolin

(Oxford University Press, Toronto. 509 pp. $15.00)

This book is dedicated to Carl Rossby one of the greatest meteorologists and oceanographers of the century, and is a compendium made by his colleagues and students that was to have honoured this great scientist on his sixtieth birthday in 1958. Upon his death in 1957 it was decided to continue plans for the book which is now published under the title *The Atmosphere and the Sea in Motion*. It is divided into five main chapters and the first one deals with the mutual influence of atmosphere and ocean. It is not possible to dissociate the motion of surface and deep water layers of the oceans from the large scale wind planetary systems and it is now agreed that oceans and seas are highly sensitive to wind stresses and their fluctuations. This chapter will help even skeptics to realize that the energy due to the wind is far greater than any other form of energy likely to be created through internal mass adjustments under the combined effects of gravitation, coriolis force, and thermal stratification.

The papers of P. Welander and W. Hansen are indicative of this trend. The problem of the warning of the North Atlantic Ocean is well reviewed by J. Bjerknes, while B. Hourwitz, H. Stommel and W. H. Munk show that the unrest of deep oceans appears to be due to variable wind stresses occurring during storms which generate internal inertial gravi-

(*Continued on page VIII*)

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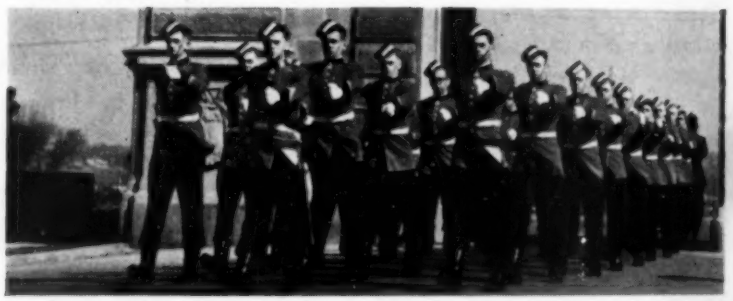

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ty waves. Observations, using shallow and deep water thermometers of atmospheric pressure fluctuations and temperatures around Bermuda island, analysed with the help of numerical analysis, using punchcards and a numerical high-pass filter method, indicate that there are fluctuations in the temperature of the thermocline. The second chapter devoted to the distribution of matter in the sea and atmosphere involves four papers. The first is of much interest to those who realize that much is involved in the changes in the carbon dioxide content of the atmosphere and sea from the viewpoint of radiation.

The third and fourth chapters are entitled "The General Circulation of the Atmosphere" and "Characteristic features of Atmospheric Motion. A non-specialist could find in them a thrilling source of enjoyment in getting acquainted with the dynamics of the atmosphere which constitutes a very challenging problem. The tool used throughout these brilliant papers is the mathematics appropriate to fluid motion with particular emphasis on problems leading to the solution of vorticity equations.

The last chapter deals with weather forecasting. This should make one

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tolerant toward the weather man who depends upon the reliability of the information he receives while transient changes in a given meteorological situation appear difficult to foresee. The book, printed in Sweden contains high quality material with careful reproduction of photographs and diagrams some of which are in colour. This edition is a real achievement in bringing together names of outstanding authors and subjects of great interest. The papers are provided with ample references and the whole book ensures that Rossby's influence will long be felt among meterologists and oceanographers.

G. E. JARLAN

Mr. Jarlan works in the Hydro-Dynamics Section of the National Research Council at Ottawa.

* * *

The Face of the Earth
by G. H. Dury

(Longmans Green & Company, Toronto. 225 pp. Pelican edition $1.00)

Another excellent little volume from Pelican Books gives an up-to-date, general and most readable account of geomorphological processes and their resultant landforms. In 213 detail-packed pages G.H. Dury has reviewed all the usual topics concisely and intelligently and has blown the dust from several of them in a most refreshing way.

Geomorphology is still a young member of the Earth-sciences but has, during the past three decades, made vigorous progress, largely as a result of the questioning and energetic approach of workers such as this author. It is interesting to see that the science of geomorphology is tending to lean more and more upon quantitative rather than qualititative studies. Dury points out several new lines of thought that have developed from this. While most of his examples are of British or European origin, much North American material is included, and the principles derived from these examples are of course universally applicable. Or, as Dury would no doubt prefer to put it, these principles may be tested the world over.

The chapters on river-patterns are particularly lucid and well illustrated and the chapter on frozen ground is especially welcome, for this latter topic has until recently been neglected in most geomorphology texts.

The text-figures are numerous and well done; the eighty-two photographs are generally very good, well chosen and clear. Only one geological error has been noted, and that is merely the reversal of two rock-group names, not very significant in themselves. Altogether this is a most praiseworthy and valuable little contribution and should be on every geographer's bookshelf.

D. L. DINELEY

Dr. Dineley is Professor of Geology at the University of Ottawa.

* * *

Late-Pleistocene Environments of North Pacific North America
by Calvin J. Heusser

(American Geographical Society, New York. Special publication 35. 308 pp. cloth bound $6.00 Paper bound $4.00)

As Professor H. P. Hansen notes in his foreword to this book, palynology has come a long way since the presentation of the first paper on modern pollen analysis by von Post at Oslo in 1916. Within the last two decades especially it has become a most important part of our Quaternary studies, with successful schools in Europe and North America. During this time its limitations have been recognized and its techniques refined, so that the often unconsolidated and apparently unfossiliferous deposits of Pleistocene and Recent times have now begun to yield rich rewards of information about the chronology,

climates and vegetational ecology and history of the Quaternary era. The North Pacific area of North America is perhaps an obvious area for intensive study, with its wide variety of physiographies, climatic conditions and vegetation cover. It is, however, also a region of geological youth and instability, of tremendous size, and is clearly one to be approached with the greatest of caution.

Dr. Heusser has carried out a survey of the palynology of Quaternary deposits scattered broadly along the coastal belt from the Aleutian Islands to Washington and though the sites are less than 100 in number, his work immediately impresses one with its meticulous attention to regional setting, stratigraphic detail and careful preparatory technique. While Dr. Heusser would probably be the first to admit that this work merely touches the surface of the material available and outlines the problems involved, it is much more than a reconnaissance study and it is likely to serve as a guide for all interested for many years to come. Most important, the snags and possibilities of error are carefully evaluated and the author shows himself to prefer a guarded approach to them. He also seems to prefer the more modest implications of his palynological findings, which at this stage is undoubtedly very wise.

This investigation was carried out over eight field seasons and the immense amount of data was clearly collected with care. No pains have been spared to present these data in their regional setting; in this respect the early chapters on late Pleistocene physiographic events and on regional climate and vegetation are very welcome — indeed for most of us they are essential. They present the facts succinctly and in logical sequence. Here, however, one might wish for a greater use of maps and diagrams. No single map is larger than page size (8.3 x 6 inches) and much of the topographic detail is reduced beyond a useful minimum.

The long stratigraphical chapter is compact and illustrated by admirable (though often too small) sections and figures showing the lithologies and pollen and peat stratigraphy. These are the vital data upon which the accounts of late-Pleistocene vegetation, environments and chronology are founded. With the diminution and virtual disappearance of the Cordilleran Glacier Complex and the ensuing spectacular isostatic recovery, the newly ice-freed land has been reclaimed by a succession of floras as climate and terrain have offered opportunity. Migrations can be traced and a time-scale is drawn up with dates fixed by radio-carbon analyses. This is summarised most clearly in tables 5 and 6, while table 7 suggests acceptable correlations between the Pacific North-west and other parts of the world where palynological sequences have been established.

Several aspects of the presentation are particularly pleasing. The style of writing is uniformly good; the Abstract preceeding the main account is welcome, as are the appendices, glossary of terms used and the list of literature cited. The twenty-five plates are collected at the end of the book, a practice no doubt dictated by economy but nevertheless rather irritating. Some of them are excellent. This book will probably not appeal directly to a very large number of readers, but those who are interested in the more recent geological and botanical events and in the Pacific coastal north-west will find it a very satisfying volume.

D. L. DINELEY

Dr. Dineley is Professor of Geology at Ottawa University, Ottawa.

Recently Received from Publishers

The Lawn Book. By Robert W. Schery. (Brett MacMillan Limited, Galt, Ontario.) A detailed guide for making and managing a grass lawn with the seed best suited to any given soil; a most comprehensive book for lawn-keeping for the benefit of the home.

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